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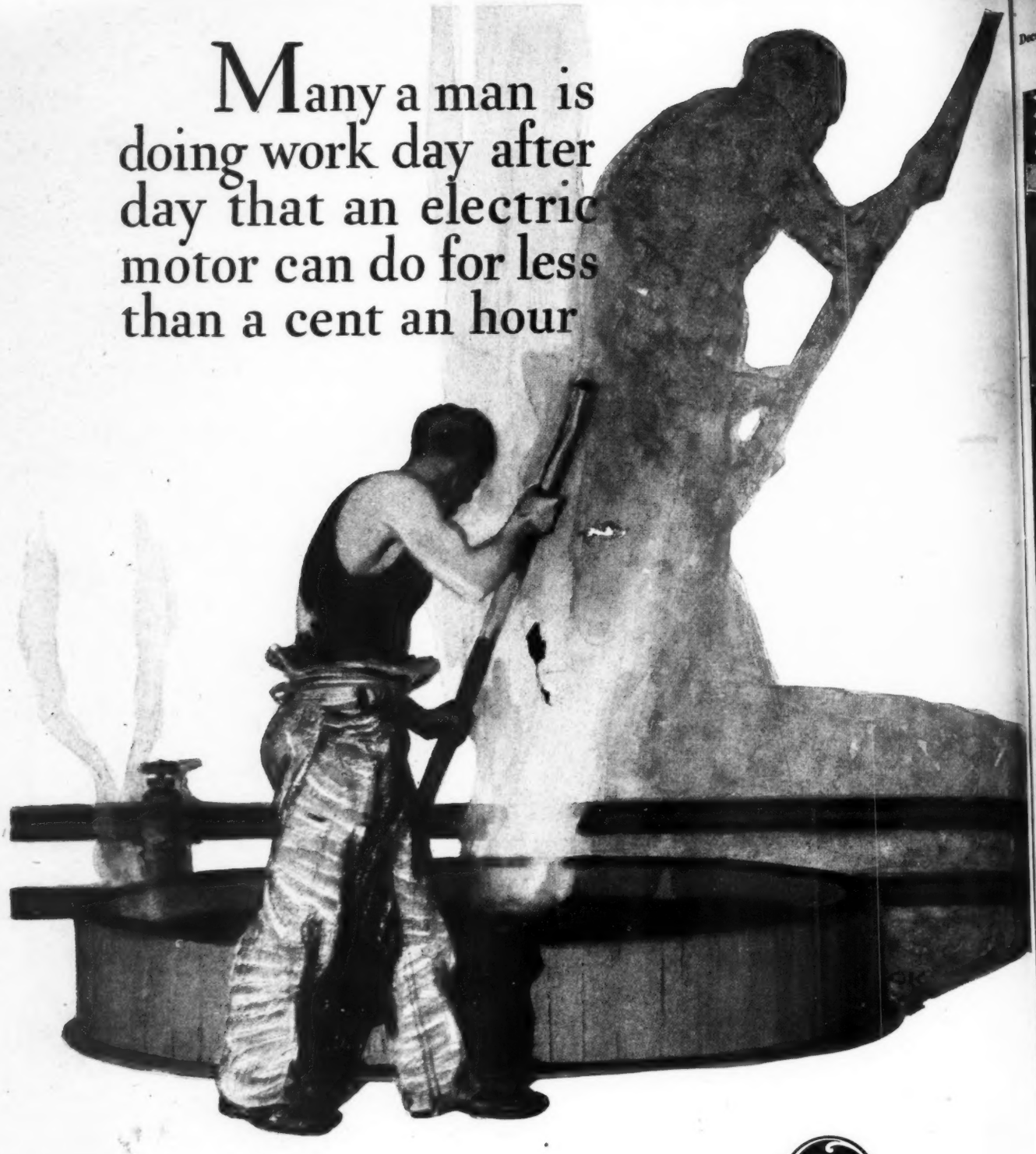

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Here Is a *New Way* to Make Your Money *Earn More*

By WALLACE AMES

Financial Editor

"I SAW some figures today that make me sick," remarked Carl Cutler one evening as he and his wife and two neighbors sat down to an evening of Bridge.

"Yeah?" said Phil Ogden, just mildly interested in further enlightenment.

"They were figures showing gains in securities between 1923 and 1927," continued Carl, who needed little encouragement to go into details. "Do you know, if I had invested $1,000 in American Can at the low price in 1923 I could have sold it for $5,424 in 1927. $1,000 in Pere Marquette would have given me $4,028; $1,000 in General Motors went to $7,980; American Water Works! Wow! $1,000 in that stock would have netted me $22,500! Why shouldn't such figures make me sick?"

"Now I'll tell one," interrupted Phil. "In 1923 I invested in American Agricultural Chemical at 36; recently I saw that stock quoted at 13½, I got into American Woolen at 87 and out at 24. I thought Central Leather was a buy at 32; it has since dipped below 10. Middle States Oil nicked me for a row of good iron men when I bought at 11 and sold at 2¼. Figures sometimes make me sick, too."

"So you're the guy who bought those stocks," laughed Carl Cutler.

"IT'S fine for you to be talking now. Anyone can tell what is going to happen after it is all over. Those stocks had plenty of friends when I bought them." Phil had a good defense.

"Furthermore, if you had bought any of those rich babies," said Phil as a further rejoinder, "you wouldn't have held them. You would have grabbed 10 or 15 points profit and today you would be just as sick to think of the real big profit you let slip away.

"In spite of the losses I took and the profits you didn't make I am still of the opinion that there must be some way for 'little fellows' like you and me to invest shrewdly with our $100 or $1,000 or our occasional $5,000 and I think I have found the way." As Phil was all warmed up to go into details and Carl an interested listener, the bridge game broke up, the wives began to talk of their next shopping trip and the men to discuss investments.

"The greatest truth I got out of this little investigation that I am telling you about," Phil went on, "is the value and importance of diversification. Suppose, as an extreme instance, in addition to the stocks on which I lost money, I had bought those you mentioned that have gone way up. I would have made money even after swallowing my losses.

"The investments of insurance companies and savings banks are safe for two reasons. They buy good securities in the first place. In the second place they invest in so many different securities that a loss in one is not serious."

"Yes," Carl chimed in, "but insurance companies and banks have millions to invest to your and my hundreds."

"THIS plan I have been looking into takes care of that, too," Phil assured him. "It is called an investment trust. It gives you the practical advantages of a million-dollar investment fund and you can invest small amounts such as $100 or $1,000 or $5,000.

"As it was explained to me, the investment trust sells us its own stock or bonds. By selling to a lot of people it raises maybe two or three million of capital. It uses this capital to make investments all over the world, wherever conditions are good. It invests in many kinds of industry; gets extreme diversification.

"The trust has all sorts of records and information to go by and experts to study them and decide what is best to do. In 1923 a well-managed investment trust probably would have invested pretty heavily in stocks as prices were low and bound to go up sooner or later. In 1927 the same trust would have sold most of its stock at a profit and invest the money in bonds.

"An investment trust makes most of its money from stock dividends and bond interest. But it also makes money buying low and selling high. Holding such a large number of securities it is entirely probable to own some which offer substantial market profits."

"DO YOU mean to tell me," Carl broke in, somewhat excitedly, "that investment trusts make the fabulous profits shown in those figures that gave me such a pain?"

"I doubt it," Phil answered. "In fact I don't believe anybody gets such profits. One isn't likely to be lucky enough to buy at the very bottom, hold on and sell at the very top the stocks that make the biggest advances.

"Furthermore, a well-managed investment trust is a sane, conservative business. If one of its investments advances materially and the trust managers believe the top has been reached, they would probably sell and take their profit. They would sell out a security in which they had no market profit if they thought to hold it would likely result in loss.

"After a trust sells a security to take a profit, it may go still higher. After they sell to avoid a loss the impending trouble may be averted after all. But on the average the trust's trained judgment as to when to buy and when to sell is probably sound.

"You and I, by owning stock or bonds in an investment trust get our share of the success of its operations in the shape of extreme safety plus interest or liberal dividends."

"That all may be true," said Carl, "But I do not intend to have anyone controlling my investments. I'll pick and choose what I like and buy or sell when *I* think best."

"Isn't it a fact, Carl, that you really buy or sell on somebody's say so? You invest in this or get out of that because someone in whom you have confidence tells you it is the thing to do."

"Well, I guess that's so," Carl agreed, beginning to come around to Phil's way of thinking.

"Furthermore," Phil added, "a good investment trust not only has expert management, but the By-laws specifically state just what can or cannot be purchased. Get a copy of the By-laws before you make your investment and if you are not satisfied with their provisions there are plenty of other trusts for you to choose from.

"These propositions I am talking about are *investment* trusts. They are not speculative schemes. None of them will tell you that they bought Ford stock when Henry was starting to make flivvers. Probably not one of them would tell you that they made 1,000% or 2,000% in American Water Works. But I know of one that made 60 points in Allied Chemical. It went higher after that, but the trust had a nice profit and conservative judgment said take it.

"In fact, there was no American investment trust when Ford was looking for money. The first one is only a few years old. The idea originated in Scotland and England fifty or sixty years ago but the plan was not introduced over here until recently. Those old British trusts that have built up their surplus, investing and re-investing, a' ways conservatively, but none the less shrewdly, now pay 20%, 25% and

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Here is the ANSWER

to questions which bother many investors

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Make Your Money Earn More

(*Continued from page 4*)

sometimes as high as 30% on their original stock. And they are thought so well of that their stock often sells in the London market on a 5% basis or even less."

"So it's a Scotch idea," said Carl. "Well, it must be good. Can you give me the name and address of the investment trust you have been looking into?"

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

How to Build an Independent Income (1927 Edition)—Describes a plan for buying 6½% First Mortgage Bonds by payments of $10 or more a month, and shows the results that may be accomplished by systematic investment. Address: The F. H. Smith Company, Smith Building, Washington, D. C. Ask for Booklet 75.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

Behind the Scenes where Bonds Are Made tells how you can retire in fifteen years and have an income equal to your present living budget. This booklet can be secured by writing to Cochran and McCluer Company, 46 North Dearborn Street, Chicago, Ill.

Thirty-two page illustrated booklet, describing one of the largest public utility companies, of interest to investors. Utility Securities Company, 230 S. LaSalle St., Chicago, Ill.

The Common-Sense Test of Investment Trusts suggests an easy method by which you may correctly judge the worth of any investment trust before putting your money into it. United States Fiscal Corporation, 50 Broadway, New York, will send a free copy if you request Circular CS.

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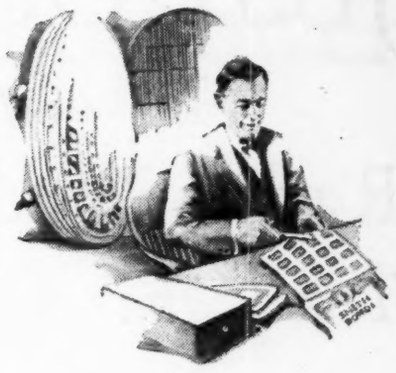

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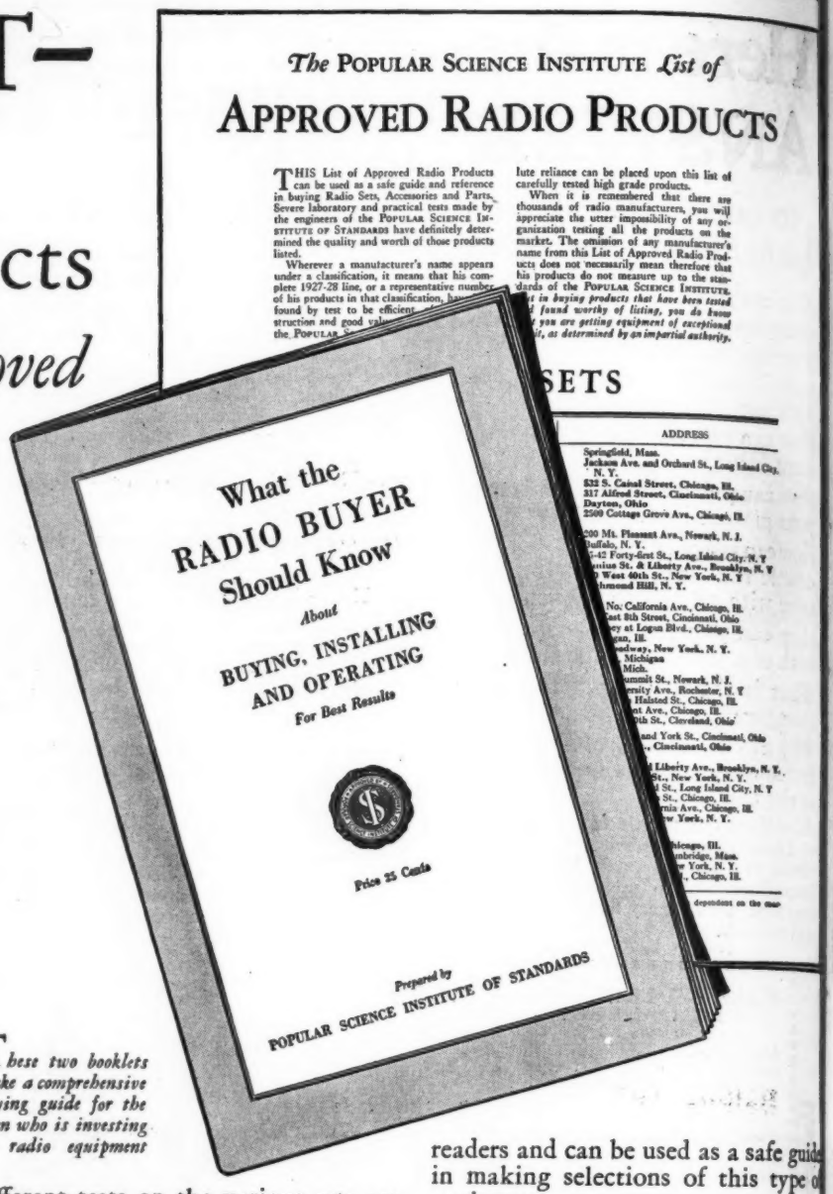
JUST as new models of automobiles are brought out annually at one season, there is now a definite time of the year when practically all new radio products for the year are put on the market. This is logically in the fall when radio interest is at its height—the long winter evenings ahead, extra fine radio features, together with the Christmas gift problem, being largely responsible.

While the Popular Science Institute of Standards issues at intervals during the year up-to-date bulletins listing radio products approved as the result of tests, it finds that a *completely revised* list is necessary in the fall.

Toward the end of July, manufacturers start sending in to the laboratories of the Popular Science Institute early production models of their new 1927–28 **equipment.** Then begins the very busiest season of the year for The Institute's radio engineers.

Tests are made in relays, one test on one type of product being run at a time. For instance, in the case of radio receiving sets, a group of receivers are put through the selectivity test at one time. Next, each of the sets are subjected, one by one, to the test that accurately determines their rating in so far as tone quality is concerned. And, so on, with the other tests essential for judging the general merits of a radio receiver. The results of the different tests on the various sets are carefully noted, in each case.



These two booklets make a comprehensive buying guide for the man who is investing in radio equipment

No final determination of worth is reached, however, until all the tests on all the sets have been made. Then the new 1927–28 standards for radio receiving sets are established and the test notes regarding the various receivers are checked against these. It is then that a decision is reached as to which of the radio sets are to receive endorsement and approval.

The same thing applies to other types of radio equipment. In the case of many products, such as socket power devices, vacuum tubes and other apparatus containing parts of limited life, a very long period of time must elapse before the final determination of worth is made. This is due to the "life tests" that are necessary.

The publication of the new Approved List of Radio Products in the fall represents, therefore, the results of weeks of testing and the establishment of new standards, and is of definite news value. This bulletin is available at no charge to all Popular Science readers and can be used as a safe guide in making selections of this type of equipment.

Another publication that the Popular Science Institute of Standards has put out this year represents a further aid to the man who is buying a radio outfit and wants to get the most from his investment. This is a 20-page booklet entitled "What the Radio Buyer Should Know." Besides telling you what you can expect in the way of radio reception, how much you must pay, how the cost can be cut down and other pointers on buying, it also contains full instructions on installation and nine pages are devoted to hints on operation—such as tuning for selectivity and tone, eliminating noise and other points that the radio owner should know. There is a charge for this booklet of twenty-five cents.

In publishing this and the List of Approved Radio Products, the Popular Science Institute feels that it has covered the buying problem as carefully and thoroughly as can be done. To secure these, address the Popular Science Institute, 250 Fourth Ave., New York City.

Popular Science Monthly
GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS

Whatever type of radio power equipment you want—

WITH BATTERIES OR WITHOUT

Licensed under Hammond-Andrews patent

Balkite "A" *Contains no battery.* The same as Balkite "AB," but for the "A" circuit only. Enables owners of Balkite "B" to make a complete light socket installation at very low cost. Price $35.00.

Balkite "B" *One of the longest lived devices in radio.* The accepted tried and proved light socket "B" power supply. The first Balkite "B," after 5 years, is still rendering satisfactory service. Over 300,000 in use. Three models: "B"-W, 67-90 volts, $22.50; "B"-135, *135 volts, $35.00; "B"-180, 180 volts, $42.50. Balkite now costs no more than the ordinary "B" eliminator.

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Standard for "A" batteries. Noiseless. Can be used during reception. Prices drastically reduced. Model "J,"* rates 2.5 and .5 amperes, for both rapid and trickle charging, $17.50. Model "N"* Trickle Charger, rate .5 and .8 amperes, $9.50. Model "K" Trickle Charger, $7.50.

*Special models for 25-40 cycles at slightly higher prices.

Prices are higher West of the Rockies and in Canada.

for whatever type of radio set you own— whatever you want to pay for it—

Balkite *has it*

First noiseless battery charging. Then successful light socket "B" power. Then trickle charging. And today, most important of all, Balkite "AB," a complete unit containing no battery in any form, supplying both "A" and "B" power directly from the light socket, and operating only while the set is in use. The great improvements in radio power have been made by Balkite.

This pioneering has been important. Yet alone it would never have made Balkite one of the best known names in radio. Balkite is today the established leader because of Balkite performance in the hands of its owners.

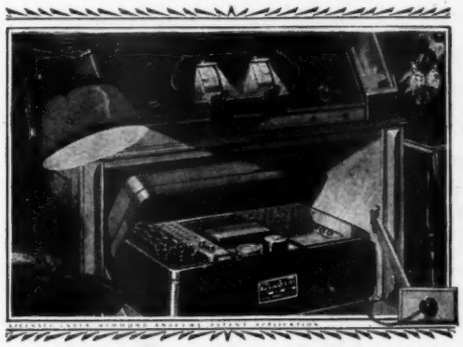
Because with 2,000,000 units in the field Balkite has a record of long life and freedom from trouble seldom equalled in any industry.

Because the first Balkite "B," purchased 5 years ago, is still in use and will be for years to come.

Because to your radio dealer Balkite is a synonym for quality.

Because the electrolytic rectification developed and used by Balkite is so reliable that today it is standard on the signal systems of most American as well as European and Oriental railroads. It is this principle, used in all Balkite Radio Power Units, that does away with the necessity of using tubes for rectifying current—that makes Balkite permanent equipment with nothing to wear out or replace.

Balkite has pioneered—but not at the expense of the public.



Balkite "AB" *Contains no battery.*

A complete unit, replacing both "A" and "B" batteries and supplying radio current directly from the light socket. Contains no battery in any form. Operates only while the set is in use. Two models: "AB" 6-135, *135 volts "B" current, $64.50 "AB" 6-180, 180 volts, $74.50.

Today, whatever type of set you own, whatever type of power equipment you want, whatever you want to pay for it, Balkite has it. Production is so enormous that prices are astonishingly low.

Your dealer will recommend the Balkite equipment you need for your set.

FANSTEEL PRODUCTS COMPANY, INC., NORTH CHICAGO, ILLINOIS

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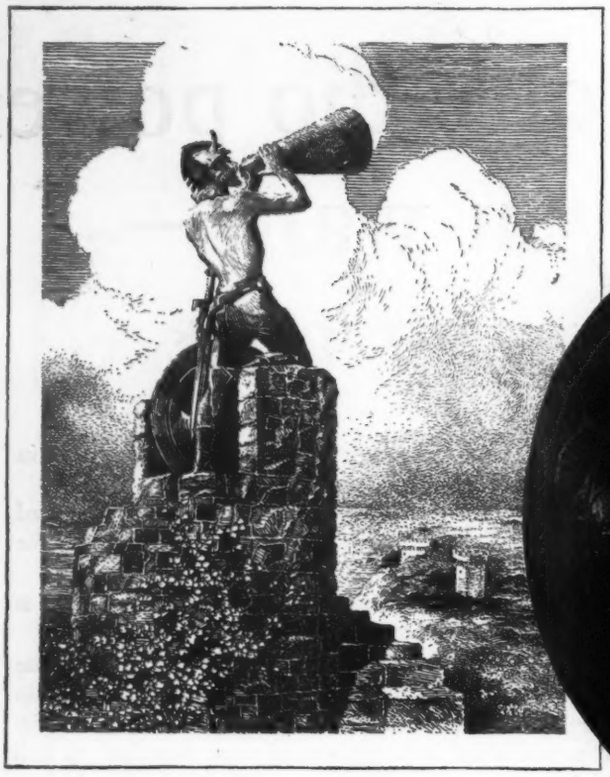
Willesden, London, N. W. 10

FANSTEEL

Balkite ®

Radio Power Units

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



When the Gauls transmitted important news, it was shouted from tower to tower through a megaphone. Within fifteen hours the news of the Roman massacre at Orleans was thus sent to Auvergne 120 miles away.

Natural Tone—Perfection in radio reception is naturalness of tone. It must reach you as it left the studio—clear and life-like. It must be rich, deep, resonant—admitting no trace of "radio accent".

Nothing is so fatal to tone quality as an "unsympathetic" loud speaker. Reception suffers unless set and speaker work in perfect harmony.

Grebe has built a *Natural Speaker*. With it your set will reproduce tone more clearly and faithfully, affording you purer tone quality.

But in combination with the Grebe Synchrophase Seven, it attains its highest capabilities.

The Grebe Natural Speaker is priced at $35; the Grebe Synchrophase Seven at $135. Send for Booklet P; then ask a Grebe dealer to demonstrate both of these Grebe masterpieces in combination.

GREBE SYNCHROPHASE RADIO

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Makers of quality radio since 1909

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Popular Science MONTHLY

FOUNDED 1872 — FIFTY-SIXTH YEAR

DECEMBER, 1927 SUMNER N. BLOSSOM *Editor* VOL. III, NO. 6

Rubber from Weeds

My New Goal—EDISON

The Great Inventor Tells How Today, at Eighty, He Is Solving the Hardest Problem of His Life

By FRANK PARKER STOCKBRIDGE

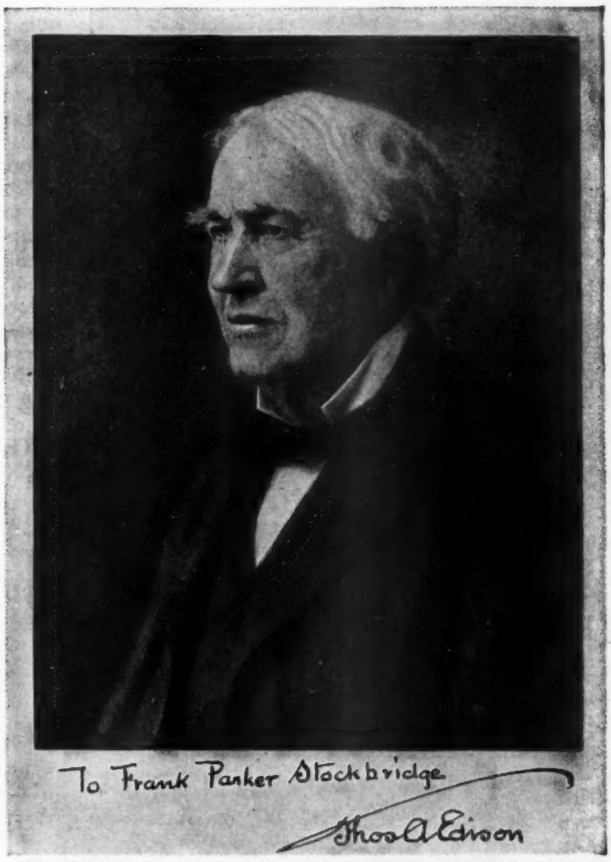
I HAVE just been privileged to watch the man who has changed the world in the act of starting another revolution.

Thomas A. Edison, at eighty, is beginning a new line of research. Rubber—"the most complicated problem I have ever tackled," he told me—is the objective of this investigation, begun at a time of life when most men have long since retired, when few are still able to work at all.

Nine hours a day in his laboratory, three or four or five hours every evening in his library, engrossed as deeply as he ever was in the problems of the multiplex telegraph, the electric light, the telephone, the phonograph, the motion picture or the alkaline storage battery.

For more than fifty years the question "What is Edison working on now?" has been important to the whole world, for he has been producing one revolution after another, in the habits, the thoughts, the business customs, even the manners of the world.

Mentally listing the Wizard's achievements—the microphone and the tasimeter, those marvelous instruments which detect, respectively, sounds previously unheard and minute temperature changes not before suspected; the mimeograph, which revolutionized business methods, and its offspring, waxed paper, which revolutionized food distribution and the culinary habits of a nation; the grinding machines which have made Portland cement better and cheaper; the system of power distribution which has altered all industrial methods; the electric railway and the stock ticker, the megaphone and a dozen other minor devices of everyday use—listing these with the other and more widely known creations of Edison's brain, and contemplating the changes which have come over the world in this half-century which history may call the "Age of Edison," it seemed to me that some highly important and interesting questions remain to be answered.



The Wizard who seeks to grow rubber in America and refine it by machinery—seeks in what he calls "the only way," ceaseless study and experimentation in the laboratory twelve hours and more a day

How does Edison determine what to invent? Having determined that, how does he go about it? What is the secret which has enabled one man to turn the world upside down in his own lifetime?

I went to West Orange, New Jersey, to the vine-covered brick laboratory at Llewellyn Park which has been the Wizard's workshop for forty-five years, to see if I could find the answer. I found it.

EDISON told me what he is doing, how he is doing it, how he came to undertake it. And in the telling he disclosed his secret—the secret of how great inventions are made!

It began as every important invention starts—with the determination of an economic need for it. Ben Franklin stated it concisely: "Necessity is the mother of invention." When Brush showed his arc light at the Centennial of 1876, young Edison saw the economic need of an electric light which could be divided into smaller units, and out of that need sprang the incandescent lamp.

"The United States never has and never will have on hand enough rubber to run the country for more than a year," Edison told me. "Henry Ford, Harvey Firestone and I were considering what this country would do in case of a war which cut off our rubber supply. Don't make any mistake about that war; it will come. We may run along for a

good many years without it, but sooner or later the nations of Europe will combine against the United States. The first thing they will do will be to cut off our rubber supply.

"WE CAN'T fight a war without rubber. All our transportation is on a rubber tire basis. To move goods to and from railroads and steamships we must have rubber. There are not enough horses and mules to haul the commerce of peace time, let alone war. Except on the farms, the supply of horses is diminishing all the time.

"So we decided that the thing for us to do was to find a source of rubber, for war emergency purposes, so that we can produce it quickly right here at home. And that is what I am working on now."

"You are not interested in rubber as a commercial product, then?" I asked.

"Not at all," replied Mr. Edison. "Please get that right. What Ford, Firestone and I are doing is—well, I call it a 'stunt'—something in which there is no possible profit for us. We can't compete commercially with the tropics in the production of rubber."

Edison and his friends, Ford and Firestone, have been experimenting for several years on their Southern Florida lands with the cultivation of the standard varieties of rubber trees and plants, and with numerous sub-standard kinds. For forty years Mr. Edison has been developing at his winter home at Fort Myers, Florida, the most complete garden in existence of tropical and sub-tropical vegetation; on Mr. Ford's 18,000 acres at La Belle, near by, rubber trees of every known sort have been growing for ten years and more. And—"we can't compete with the tropics in commercial rubber," says Edison.

"The home of rubber is in the tropics," he went on. "The wages on the plantations are thirty cents a day. The commercial production of rubber from the trees which constitute the principal source of it, requires an immense amount of labor. American workmen can't and should not be asked to work for the low wages necessary to make commercial rubber cultivation possible.

Rubber drying on tall poles on a plantation just outside Singapore in the Federated Malay States

"SO COMMERCIAL rubber in the United States in competition with tropical rubber is out of it, except for a limited amount of guayule rubber being produced in California by the Inter-Continental Rubber Company. They ship several thousand pounds a week of rubber extracted from the guayule shrub. It is a recognized product, quoted on the Rubber Exchange. They started in Mexico, where the guayule grows wild, but they had some trouble there with government interference and moved to California.

"But all the guayule rubber grown in the United States will not provide a large enough supply in case of war. We use nearly four hundred thousand tons of rubber a year, and it all comes from the tropics, except what I have just spoken of. In time of peace that is all right. Some of the rubber plantations are owned by American capital, and more will be. So long as we can run our ships without interference we can get all the rubber we want at a fair price."

Rubber for war—that is the economic need which has spurred Edison to his latest inventive effort. But the objective must be specifically defined. In the case of the electric light—which offers the closest parallel among his inventions to his present rubber problem in the manner of its development—the terms of the objective were based upon the existing standards of lighting, furnished by gas. The new light must compete commercially with gas in cost of production and delivery to the consumer. The lamp itself must cost so little, require so little attention and last so long as not to be a noticeable charge.

So in taking up the rubber research, Edison, Ford and Firestone worked out the definite objective to be pursued by Mr. Edison, by comparison of what he was to seek with existing standards.

"What we must find is something which will give an adequate supply of rubber at a price of around two dollars a pound," Mr. Edison told me.

"That would be a high price in peace time, but not in time of war. There would not even be an end to joy-riding with rubber at two dollars. We paid as high as a dollar and a quarter only two or three years ago, and nobody stopped buying tires.

"To get rubber at two dollars means doing everything by machinery. The rubber tree has to be tapped and a small amount of latex collected by hand each day. That alone would eliminate the rubber tree, even if climatic reasons did not."

"Those considerations don't eliminate the guayule, though," I suggested, for guayule rubber is produced almost entirely by chemical or mechanical labor-saving processes.

INSTEAD of yielding a sap, or latex, like the rubber trees of the tropical plantations, the guayule shrub, not much more than a foot high and producing more than ten percent of its weight in dry rubber, contains the gum in all of its cells except the wood of the trunk. The bark and roots contain the most. The shrubs are uprooted, washed and ground, and the rubber is then either dissolved out by a secret chemical method—the process used in the Akron rubber factories to which the dry shrubs are shipped—or by the mechanical agglomeration of the rubber particles—the process used in California to produce pure rubber for shipment.

Mechanization of the whole process has made it possible for guayule rubber to compete with imported rubber; and there are authorities that say more than 130,000 square miles of desert land in California, Arizona, New Mexico and Texas will grow guayule. But Mr. Edison negatived my suggestion.

"Not enough of it, and it takes too long to mature," he said. "They had a lot of trouble getting it to adapt itself to California conditions. And we can't wait for war to begin before starting guayule plantations. It takes five years for the shrub to grow large

Rubber on the Edison farm at Fort Myers, Fla., the most comprehensive tropical and sub-tropical garden extant, where the Wizard grows every rubber plant and possible rubber plant obtainable

enough to yield rubber enough to make it worth while.

"We must find something which will produce enough rubber, within a year after the beginning of war, to replace the year's supply which we normally have on hand; something which won't be occupying valuable land meantime or tying up capital or requiring a continuous expenditure of money without any return."

"Something like a wheat crop?" I asked.

"EXACTLY," Mr. Edison answered. "An annual crop, something which the farmer can sow in the field, by machinery, which will come to maturity in eight or nine months, which can then be harvested by machinery and from which rubber can be obtained by processes almost entirely mechanical, with the least amount of hand labor. It must be something which will stand light frosts, for there is no part of the United States where there are not occasional frosts. Probably it will be grown in the South, but not necessarily. And the farmer ought to make a dollar a pound profit, to encourage him to grow it."

There I had it, the clearly defined picture of the specific objective of the inventor's quest. No hit-or-miss affair, this. "But what are the steps whereby the inventor actually invents?" I asked him.

"I don't like to talk much about rubber until I know more about it," he demurred, with a smile. "I have hardly got started yet. The first thing is to find out everything everybody else knows and begin where they leave off. So I started by reading every book, pamphlet and document of every kind that I could lay my hands on, that had anything to do with rubber. It is a very large subject." He waved his hand toward a big table near his desk, piled high with huge volumes and tiny pamphlets. Many were the famous Edison note-books, of which there are thousands, bound, classified and indexed. They contain the minute records of his great inventions, step by step. With one of his staff, Barukh Jonas, who reads a dozen languages, he had just spent five days in the library of the New York Botanical Gardens, digesting hundreds of volumes on rubber in Spanish, Portuguese, German, French and other languages.

ONE day last Summer, an associate told me, Mr. Edison learned of a new book on rubber just published in Germany. No copies had reached America.

"Send a man to Germany by the next ship to bring me a copy of it," he instructed his secretary. A cabled order served, however, but not until he reads this, if he does, will Mr. Edison know that the precious volume was not personally conducted from Bremen.

"I am still going through the books," Mr. Edison went on. "I am trying to get the whole subject so thoroughly into my head that I can view every phase of the problem in the light of thorough knowledge. That is the only way to study a subject, to read all the literature on it at one time."

Therein the inventor disclosed another secret of his genius. Because his biographies describe him as a train newsboy with only three months of formal schooling, there has grown up an Edison myth of a poor boy, uneducated and entirely self-taught. As a matter of fact, Edison's parents were well-to-do and his home education from his mother, formerly a successful teacher, was probably the most intensive and comprehensive ever acquired by a boy of his time. Having digested before the age of twelve such tomes as Gibbon's "Rome" and Hume's "History of England," every book on science which was obtainable and all but the mathematics of Newton's "Principia," he became a railroad "newsie" because it enabled him to read the latest publications, gave him five hours every day to study in the Detroit public library, and provided money for the precious chemicals with which he performed every experiment described in the books. The true picture of young Edison, the "tramp telegrapher," shows him spending every dollar of his wages above the poorest kind of living, for books and chemicals, reading lines of print as rapidly as others read words, always a student, always the intelligent, scientific experimenter. Nothing he has ever done was accidental; everything has been founded upon thorough scientific study and thoroughly scientific experiment.

"I know of no man in history with such a thorough grounding in science as Edison has," one of his old associates told me.

First the theoretical knowledge, then the experiments. Mr. Edison was not ready to talk about the experiments. To my question whether he had found any plants which seemed to come anywhere near meeting the requirements which he had described, his reply was evasive. "We have only just begun," he said, and I had to go to other sources to learn about the specimens his explorers are bringing from every part of the world outside of the tropics.

The weed from which Edison may make rubber. This leafless desert milkweed has been found in the inventor's laboratories to contain 5 percent of rubber. When the tops are cut off new shoots sprout

Tapping a rubber tree in British Guiana. Only a little of the sap, or latex, flows and the trees must be re-tapped and tended daily by thousands of natives

JUST as he did when seeking a fiber to make a filament in the incandescent electric light, Mr. Edison has sent and is still sending out expeditions to find every plant which yields anything like a rubber gum, and bring to the laboratory a sufficient quantity for experiment. Only last September he sent another young man to South America.

One "caravan" left a few weeks earlier for a year's tour of the desert regions of the Southwestern United States; others are scouring Europe, Asia and Africa. Already hundreds of specimens have been received and experts under Mr. Edison's immediate personal direction are testing them for rubber content and trying to devise ways for its economical extraction.

More than 250 different species of plants, many that can be sowed and reaped in the same year, have already been listed in the Edison laboratories as containing measurable amounts of rubber. Some already hold out promise of becoming, through breeding and selection, the thing for which Edison, Ford and Firestone are looking.

The most promising are of the milkweed family.

SO THE big job Edison at eighty has tackled is already well under way. There is still an immense amount of work to be done, for not only must the right plants be found and methods of sowing, cultivating and harvesting be developed by experiment, but the efficient and economical method of extracting the rubber on a large scale, by machinery, is yet to be devised. And Edison, working twelve to fourteen hours a day at the job, promises to keep at it, "at least until I have found all there is to know about rubber."

Air-Rail Lines May Span U.S.

Great Steam Roads and Government Weigh Plans to Reduce Transcontinental Time by Forty Hours

By WILLIAM P. MacCRACKEN, Jr.

"A TICKET for San Francisco please."

"Do you want to go by air, air-rail or rail?"

That question will be asked of passengers applying at ticket offices in all our large cities unless something unforeseen develops to dampen the interest of railroad executives in the practicability of coördinating passenger service by air with passenger service by rail. There are many interesting possibilities for combined air-rail trips.

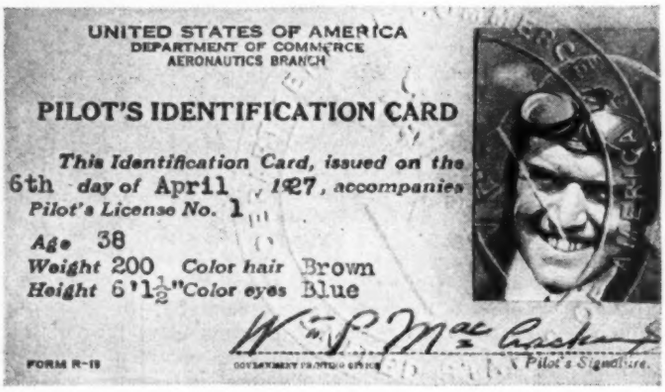
Leaving New York at 2:45 p.m., Eastern Time, on Sunday, we will say, a traveler will arrive in Chicago at 9:45 Central Time, Monday morning after bath, shave and breakfast on his all-Pullman train. He will be whisked to Chicago's new lake front municipal flying field and take off for Cheyenne, Wyo., at 10:30 o'clock. His plane will land him in Cheyenne at 6:50, Mountain Time, that evening, slightly more than thirty hours from the Atlantic seaboard. An all-rail trip, by existing schedules, would have consumed fifty-two hours of travel.

The traveler will leave Cheyenne by rail at 7:40 p.m., reaching Ogden, Utah, at 9:20 Mountain Time, next morning. A swift flight from Ogden, starting at 9:20 a.m., Pacific time, Tuesday, will place him in San Francisco at 4:30 p.m., in time for dinner—a little more than two full days after his departure from Manhattan Island.

Reduced to the language of a time-table the trip will appear like this:

	BY TRAIN	
Lv. New York	2:45 p.m. (Eastern Time)	Sunday
Ar. Chicago	9:45 a.m. (Central Time)	Monday
	BY AIRPLANE	
Lv. Chicago	10:30 a.m. (Central Time)	Monday
Ar. Cheyenne	6:50 p.m. (Mountain Time)	Monday
	BY TRAIN	
Lv. Cheyenne	7:40 p.m. (Mountain Time)	Monday
Ar. Ogden	9:20 a.m. (Mountain Time)	Tuesday
	BY AIRPLANE	
Lv. Ogden	9:20 a.m. (Pacific Time)	Tuesday
Ar. San Francisco	4:30 p.m. (Pacific Time)	Tuesday

FANTASTIC as it may seem, this schedule is based on existing time cards of transcontinental railway service, with flying time adjusted to fit the train connections. The flying time is based on present daily performance of the air mail. It is not unreasonable to assume that the development of patronage for the combined service will bring readjustment of train schedules to effect even greater saving of time. The saving effected by this time card is approximately forty hours. The fastest scheduled connections over the same route, by extra fare trains, would occupy ninety-one hours and forty minutes, from 5:30 Sunday afternoon to 9:10 Thursday morning. The air-rail combination consumes fifty-two hours and forty-five minutes.



Pilot of Commercial Aeronautics

THE first airplane pilot's license issued by the U. S. Department of Commerce went to Mr. MacCracken, Assistant Secretary for Aeronautics of the Department, author of this article. What he has to say is important because it indicates definite steps toward the air-rail transportation which was foreshadowed in the September POPULAR SCIENCE MONTHLY

NO STRAIN of the imagination is required to picture this journey as one of the everyday prospects of the early future. The matter has been taken up with the railroads by the Department of Commerce, and is under consideration as one of the possibilities in transportation development.

The plan has many points which entitle it to favorable attention.

One point is that the railways have a ready-made machinery for handling passenger traffic—ticket offices, baggage facilities, advertising departments and soliciting forces. The railroads are the normal channels of transport. The assumption is natural that air transportation would flow along the same channels. The railroads could provide fine service in this new form of travel and would prevent the fares from going into outside hands, thus offsetting whatever loss of passenger mileage their trains might suffer.

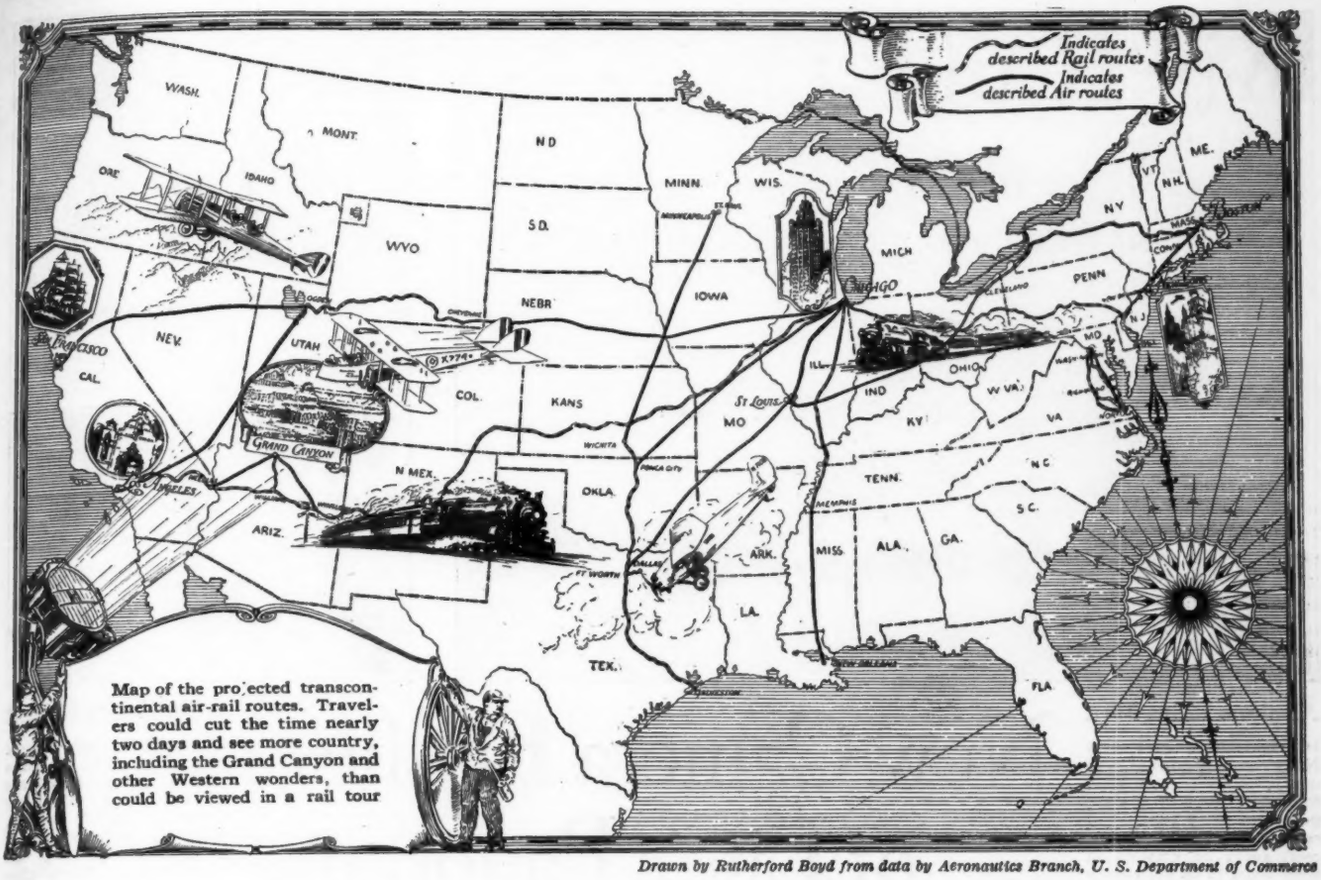
Their ticketing facilities would draw traffic that might not be attracted by isolated lines operating independently. The passenger who could make all arrangements at a New York ticket office would be more likely to patronize the coördinated air-rail service rather than change repeatedly to independent routings.

Still another factor of importance is that the greater flow of traffic attracted by the combined service would permit elasticity of facilities, enabling the roads to maintain flying equipment to meet abnormal travel demands. When a single airplane has been booked to its full capacity of eight passengers, it will be simple enough to take bookings for as many as may be required. If additional planes are not in the local "yards," they can be brought from other fields on short notice.

For the business man, whose time is figured in dollars, the possibilities of the service are too important to be overlooked. There are scores of main-traveled routes on which the timesaving would be of material significance. The banker could leave Chicago at 8 a.m., fly to Ponca City, Oklahoma, by 4:15 p.m., take train at 8:20, and sleep until he reached Fort Worth or Dallas for breakfast. If he should be bound for Galveston, and cared to spend three hours longer in the air during his first day's journey, his plane would land him in Fort Worth at 7:25 p.m., permitting him to take a night train and reach Galveston at 9:35 the next morning—less than twenty-six hours from Chicago. The rail journey takes approximately forty-eight hours.

SUPPOSE our business man wants to make a quick trip from St. Louis to Boston. Instead of taking the fast nine-o'clock train Monday morning, he could spend a large part of the day in his office, hop off from St. Louis at 1:30 p.m. Central Time, and make the five-hour flight to Cleveland in time to catch a train at 6:15 and be in Boston at 10:55 the next morning—saving half a business day in St. Louis and almost two hours in Boston.

Another striking illustration is afforded by the journey from Minneapolis and St. Paul to Fort Worth and Dallas. By rail the distance is approximately 1,100 miles. Fast through train service requires two nights and a day, or around thirty-nine hours.



Map of the projected transcontinental air-rail routes. Travelers could cut the time nearly two days and see more country, including the Grand Canyon and other Western wonders, than could be viewed in a rail tour

Drawn by Rutherford Boyd from data by Aeronautics Branch, U. S. Department of Commerce

By combined air-rail service a business man would leave Minneapolis at 11 o'clock Monday morning and fly to Wichita, Kansas—600 miles—by five o'clock in the afternoon. At Wichita he could overtake and board the identical train which left Minneapolis at 4:20 Sunday afternoon, have a comfortable dinner in the dining car, sleep in a restful Pullman, and be in Fort Worth or Dallas for early breakfast. His timesaving would be the eighteen hours that elapsed between train time at 4:20 Sunday afternoon and airplane departure from Minneapolis at 11 o'clock Monday morning.

Between New Orleans and Chicago the extra fare trains consume twenty-one hours. Instead of leaving New Orleans at 12:30 noon on such a train, the busy business man could remain at his desk till after the close of banking hours, hop off by plane at 3:30 o'clock and overtake his train at Memphis for arrival at Chicago at 9:30 the next morning.

Not only in air-rail service, but in independent routing does the airplane hold possibilities as a saver of time. A case in point is afforded by the trip from Washington to Norfolk. Because of geographical layout, and the intervention of the Chesapeake Bay, the rail routes involve a trip broken at Richmond and occupying 6½ hours. The rail distance is about 210 miles. By airline reckoning the distance is but 145 miles, which means that an airplane passenger can make it in approximately an hour and a half.

TOURIST traffic, one of the important sources of income in passenger transportation, is the major possibility of air-rail lines.

Consider the case of the Grand Canyon, in Arizona. Under present conditions of all rail service, the tourist is carried in a through sleeping car from Chicago to Los Angeles by way of the Grand Canyon. His car is cut out of the through train at Williams, Arizona, makes the sixty-four-mile trip to the Grand Canyon, and is picked up at Williams twenty-four hours later by the through train of the following day. There is a loss of twenty-four hours in reaching Los Angeles.

By air-rail combination the through passenger could leave a train at Winslow, Arizona, at 11:20 a.m., Mountain Time, leave Winslow by airplane at noon, fly over the Grand Canyon region with a leisurely stop for afternoon tea and resume his place in the same train at Needles, Calif., at 7:35 p.m., Pacific Time. By this method he would see more of the majestic scenery than he could see from an all-surface trip, and he would lose no time in his arrival at Los Angeles.

THE tourist who has not traveled by air does not know what he has missed in the enjoyment of sight-seeing. Not only does he see the general panorama, but he sees the details as well—the farmer with his plow, the crawling motor vehicles on the highway, the homes of the inhabitants, and the full cross-section of life in the country he traverses. In passing over Kansas City, for example, he sees the magnificent suburban homes and their surrounding estates in a comprehensive view that would not be possible to the surface traveler.

The idea of air touring is to have each plane accompanied by a guide. Typical service is illustrated by a trip from New Brunswick, New Jersey, to Boston.

Each passenger receives a strip map of the course, of the same general type as the maps used by motor tourists. The map shows the distance to be covered and locates towns by route markers and beacons so that the passenger always knows where he is.

The plane swings over northeastern New Jersey and southeastern New York State, while the guide points out interesting features of the shifting panorama—Newark, Staten Island, New York harbor, the Statue of Liberty, the Hudson and East Rivers, Manhattan Island and Brooklyn, Hell Gate, Long Island and the Sound. Passing over Connecticut he directs attention to the handsome estates around Stamford, the factories at Norwalk, Bridgeport and Meriden, the capitol at Hartford, and so to Boston and the State House on Beacon Hill.

Luncheon will be served from the space available at the forward part of the "car."

Cities throughout the United States are alert to the value of airports for attracting tourist travel.

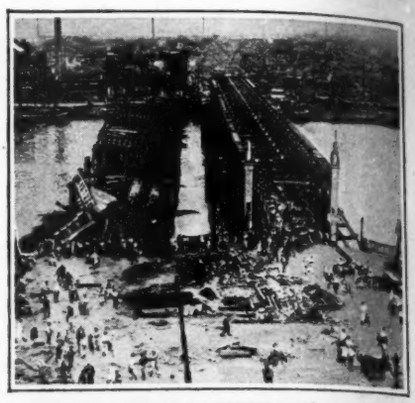
The Federal Government stands sponsor for air travel by virtue of the Congressional act creating the Aeronautics Branch of the Department of Commerce. Under this act the Department is charged with the encouragement and regulation of the use of aircraft in commerce.

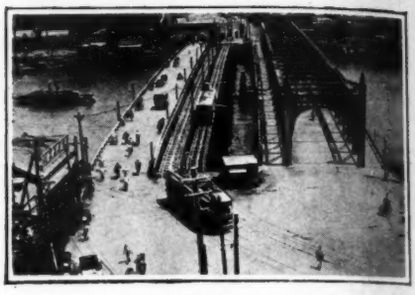
THE duties of the Aeronautics Branch include such work as establishing and maintaining civil airways, corresponding to surface highways, and the operation and maintenance of intermediate landing fields, lights, signal and radio direction-finding apparatus similar to aids furnished to water navigation. Other functions include the charting of airways and the publication of "road maps of the air," encouragement of local airports, and study of possibilities for development of air commerce, trade and industry.

New Camera Flashes of Life's Panorama

Airplane Rains Men

In eighteen seconds nine Navy and Marine Corps men jumped with parachutes from the cabin of a giant passenger plane recently in safety to show how the craft could be emptied in short order in an emergency





Ruined City Rebuilt

These photographs of the same area of Tokio, taken the day after the earthquake and fire that ruined the Japanese capital Sept. 1, 1923, and four years later, show how the city has been rebuilt better than ever. The scene is at the Azume Bridge, which was a veritable sea of flames immediately after the quake

Measuring to Billionth of Inch

A device to measure objects to a billionth of an inch is the product of P. P. Cioffi, Bell Telephone Laboratories expert. Measurements are determined by effects on a photo-electric cell

New Radio Photos

Governor Smith of New York (right) is seen examining a new radio device that will, if perfected, receive a photographic print from a photo-broadcasting station and record it on a roll of sensitive photographic paper by means of an electric light. The device is experimental and would not now be of value in a radio set because there are no stations that broadcast pictures. The Governor's photo was sent in a test

United States Deliberately Burns an Airplane

Far from being a tragedy of aviation, this remarkable scene is the prevention of one. It is an antiquated and unsafe air mail plane being destroyed at Maywood, Ill., by Federal orders to guard against its falling into the hands of "wildcat" pilots, who might try to use it with tragic results. Private owners are strongly urged to take similar precautions

Myths about Mars Exploded

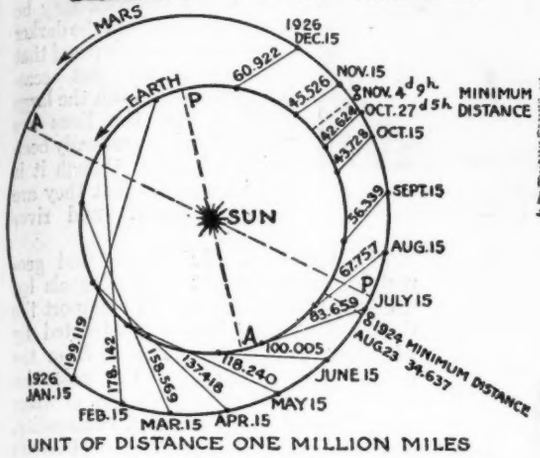


Diagram showing distances in millions of miles between Mars and earth in 1926 as they traveled around the sun, and least known distance—in 1924. A means aphelion, point farthest from the sun; P, perihelion

Planet No Home of Supermen, Says Astronomer, but Bleak Red Desert World, Arid and Freezing, Where Only the Hardiest Plants Can Live

By DONALD H. MENZEL

Lick Observatory, Mount Hamilton, Calif.

IN RECENT months astronomers, putting on new far-seeing spectacles of science, have gained the first truly authentic introduction to that most fascinating neighbor of ours in the solar community—the planet Mars. Studying the ruddy face of the mysterious traveler as he swings in his far-off path about the sun, they have observed features far different from those long painted by popular guess and fancy.

No traces of weird giants wandering over strange desert lands have they found; no mighty race of supermen, digging mammoth canals and living in a realm of mechanical wonders undreamed of on earth. Instead, they have discovered substantial facts supplanting century-old speculation—facts about the atmosphere of Mars, its climate, landscapes and probable life, from which they hope eventually to form a close acquaintance.

In short, they have revealed a new Mars—a world of frigid nights and warmer days, of high-sailing clouds and parched soil where only the hardiest of plants may grow; a place strikingly similar to the earth, yet so different that earth men, transplanted there, would pant vainly for breath through thirsty throats.

This new picture of the red planet has come about largely through the development of great telescopes, the magic of color photography, the perfection of delicate measuring instruments and the application of human logic in the interpretation of remarkable photographs taken during the closest recent visit of the planet, about a year ago.

Since Mars never comes nearer to us than 33,000,000 miles, the wonder is that men have been able to read its features at all. It is as if some friend of yours, standing on a mountain top ten miles away, were to open this magazine and ask you to read it. Even through the world's largest telescope the sentences would appear only as blurred lines, and the illustrations mere blotches. So the face of Mars, viewed through that telescope, appears streaked with lines and patches.

THE task of reading Mars, however, is complicated by the earth's atmosphere. Air currents rising from the ground often distort the image as if it were viewed across a hot stove.

Any study of Mars, then, requires two distinct operations; first, observation of the crude, blurred picture; second, the interpretation of what this picture represents.

Come with me to the Lick Observatory and have a look at Mars through one of our great telescopes. Even your untrained eyes will quickly observe that the brilliant red disk is covered with a delicate tracery of markings. There is a white spot, like a pearl button, on one edge. Next you discover a few vague green-gray shadows and, if your sight is keen, the network of linelike shading which covers the planet—the famous "Martian Canals."

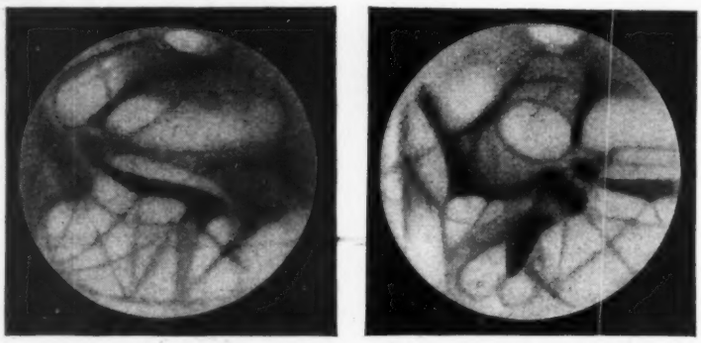
If you continue your observations long enough you will see that Mars, like earth, turns upon its axis once every twenty-four hours and a half; that the white spot is at one of the poles and changes in size exactly in tune with the Martian seasons. In the winter it is large; in the summer so small that at times it is invisible. Finally, you may suspect that there are changes in the so-called canals and the green-gray shadows—also seasonal.

So much for what you see. It is what we astronomers observe, except that, since no two persons ever see the same object exactly alike, we differ somewhat in our impressions of details. Thus, maps of Mars made by different astronomers frequently show wide variations in markings.

OUR next interest is to try to learn what the different lines and spots and shadows represent. For this the astronomer relies on his ingenuity in devising ways of using earthly knowledge and reason to translate what is visible. For example, fascinating new discoveries about the atmosphere surrounding Mars have come through applying knowledge of colors on earth to study of photographs of Mars made in colors. This method, recently employed by Professor W. H. Wright, astronomer of the Lick Observatory, is based first of all on the common observation that our atmosphere, illuminated by the sun, is blue in color. We know that the blue color of distant mountains is due to the great quantity of air in front of them. If, now, we look at these mountains through a red glass, their details are clearly visible; but if we see them through a blue glass they appear blanketed as if by fog.

Similarly, in photographs of Mars taken in red light, the solid surface of the planet is prominent, while in blue photographs the surface is obscured. From this it is possible to deduce that the planet is surrounded by a shell of atmosphere

much like ours. The exact quantity of this atmosphere cannot as yet be calculated. Certain arguments, however, which seem quite plausible, have enabled me to estimate the atmosphere at the surface of Mars as about one twelfth that at the surface of the earth. This is equivalent to the pressure in our atmosphere at an altitude of eleven miles, or less than that encountered by the highest altitude flyers. The chief assumption of this calculation is that the composition of the Martian atmosphere is not far different from that of the earth—a view made more reasonable by the discovery, at Mt. Wilson, that both oxygen and water vapor are present on the planet. This much appears certain—that the amount of oxygen available for breathing at the surface of Mars is about one thirtieth that upon the earth at sea level. Thus, a man breathing normally at twenty times a minute here would have to do so six hundred times on Mars to obtain the same supply of oxygen.

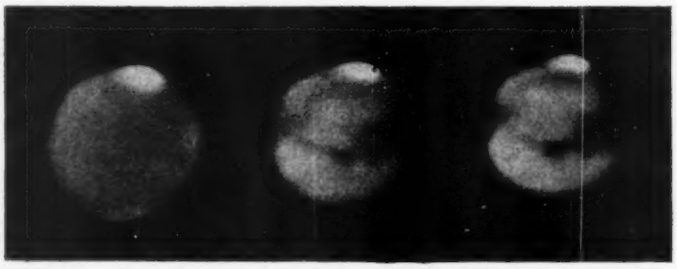


Two remarkable drawings of Mars, made by R. J. Trumpler, observing the planet through a powerful telescope. They show opposite sides of the sphere

CERTAIN blue photographs of Mars show a brilliant cloud effect invisible in the red. Evidently these are not water clouds, such as we find in our own atmosphere, for they would be opaque to the red light as well. Indeed, it is difficult to find any substance which would behave like the Martian clouds. Thus another mystery is added. In some photographs a belt of these strange clouds is seen to encircle the equator of Mars. It recalls the similar phenomenon upon our own sphere—the region of tropical storms.

By this time you will have seen and probably recognized the polar cap. There can be no doubt of its constitution, for its change in size and color and the fact that there is a cap at each pole prove conclusively that it is composed of some form of congealed water, whether of ice, snow, or mere hoar frost. The rapidity with which it melts evidences that the layer is not thick. The southern cap has been known to disappear entirely; the northern cap dwindles in size, but has never vanished. The explanation is interesting. When it is summer in the northern hemisphere, that is, when the north pole is tipped sunward, the planet is farther from the sun than when the southern summer is in progress. This tends to make the northern summers cooler.

Prof. W. H. Wright, astronomer of Lick Observatory, who makes color photographs of Mars



Three comparatively close photographs of Mars, taken through powerful telescopes, showing ice, snow or frost (the very white areas) on one pole

Another interesting fact is that the southern cap is not exactly upon the pole, but shifted some hundred miles to the south. Obviously, therefore, it must be situated either upon an elevation or in a depression; it is difficult to decide which. One may argue that high altitude will tend to retard the melting of ice, owing to the prevailing lower temperatures; or, conversely, that water, tending to seek its level, would sink into a declivity and fill it to a greater depth, thus taking longer to melt. I am inclined to favor the latter theory. Since the atmosphere of Mars is probably very rarefied, I doubt if the elevation of the cap upon a high plateau could influence to so marked a degree the disappearance of the polar snows.

As the caps melt, rifts appear in them and grow more marked until a piece of the cap will become detached and melt separately. The rifts appear in identical places each time the caps are vanishing, indicating permanent irregularities in the planet's surface.

Even though no one ever has seen a mountain on Mars, we know that the surface is not flat. The red color on the planet is to be attributed, in all probability, to the presence of iron oxide—rust—which is the pigment of most terrestrial rocks of that hue. We recall our own painted desert and it is not improbable that it somewhat resembles the Martian landscape.

In sharp contrast to the crimson background, we find the dark green-gray markings and fine network (canals) of the same color. Early observers, reasoning erroneously from analogy with the earth, thought the larger markings were bodies of water. The fact, however, that canal network may be traced distinctly in the darker areas is immediate proof that the latter are not seas. The view that both the large patches and the lines are vegetation has gradually been gaining weight, though it is not impossible that they are dried-up oceans and river valleys.

The apparent straightness and geometrical arrangement of the canals led the late Professor Lowell to support the theory that they were constructed by Martians to transport water from the poles. The thinness of the polar ice and the absence of large bodies of water attest the scarcity of that commodity, and one cannot but admire Lowell's ingenuity. But since the width of the canals often exceeds 100 miles, they cannot be waterways.

IT APPEARS from the photographs now that the canals are by no means as straight as most observers psychologically draw them. In places the lines are crowded, intersecting, without apparent system.

Recent photographs likewise show that marked changes take place on the planet. Three views, taken in 1909 at the Yerkes Observatory and in 1924 and 1926 at Lick, reveal distinct alterations in the markings. As for the temperature, the melting of the polar cap makes it almost certain that the surface is warmed at least to thirty-two degrees F. Since Mars is about half again as far from the sun as is the earth, its average annual temperature would undoubtedly be lower than ours. The climate of our earth is greatly influenced by the oceans and the thick atmosphere. Water is about five times better than rock as a heat container. During the day the earth's moist envelope is laying up a store of heat which it reradiates during the night. Mars has no such convenient foot warmer. Furthermore, our heavy atmosphere acts like a blanket, whereas Mars has relatively but a thin sheet. We may thus expect to find, for that planet, extreme differences between day and night temperatures.

Astronomers have been able to hitch electric thermometers (thermocouples, as they are called) to their telescopes and actually measure the heat from the planets. Such observations, made at the Lowell, Lick and Mt. Wilson Observatories, have proved conclusively that the temperature of (*Continued on page 167*)

Kakapo—after the cadet class had lined up—called Kaka to one side and gave him instructions. Whatever it was it had to be relayed

Kaka *and* Kakapo

What Happened When Ten Air Service Fledglings Obeyed and Followed the Bird Who Couldn't Fly

By ANDREW A. CAFFREY

Illustrated by Clayton Knight

KAKA and Kakapo, respectively, were not the family-given Christian names under which Lieutenant Perlin and Major Poe moved and had their being officially. But Cadet Booth Delano, being up in bug and bird-ology, had renamed them in that order: Kaka Perlin and Kakapo Poe. Apt epithets, too!

"Now, look here, Delano," somebody had said upon the occasion of the offhand, double christening, "you're over our heads with your bird lore. What's a kaka, to say nothing of a kakapo?"

"Well, you plebs know what is it a kiwi?" Cadet Delano questioned and stated at one and the same time. "All Air Corps birds know that a kiwi is a flightless fowl, an apteryx found in New Zealand. So, also, is the kaka a New Zealand bird, a parrot; while, strange as it may seem, the kakapo is the kaka's first cousin—through intermarriage with kiwis—and has well-developed wings but does not fly.

"Now Lieutenant 'Kaka' Perlin, as you've noticed during your weeks in this cadet class, parrots beautifully to his superior's first-parroting. And, after a strange fashion, Kaka can fly. Oh, not that he zooms and spins with the gay abandon of a light-hearted, lighter-headed cadet, but he does go aloft now and then. And here's to any man who goes up to the sky in ships.

"Kakapo Poe—Major Kakapo—has the biggest pair of chest wings on record; yet, like the other swivel-chair kiwis of Web Field, Kakapo flies not at all. But he talks much and loud, repeats the same thing day after day, and leads one to believe that he is the flyingest bird in the cage. That is, if one be not too gullible, which we near-citizens and far-from-soldiers are not.

"And poor little Kaka, the first lieutenant of the second part, comes to heel and, echoing Kakapo's every order, gets in bad all along the line. . . . Don't any of you high-class cadets ever become lieutenants if you can possibly make the grade of second-class private.

"This meeting will adjourn to the flying field afront the big steel hangars."

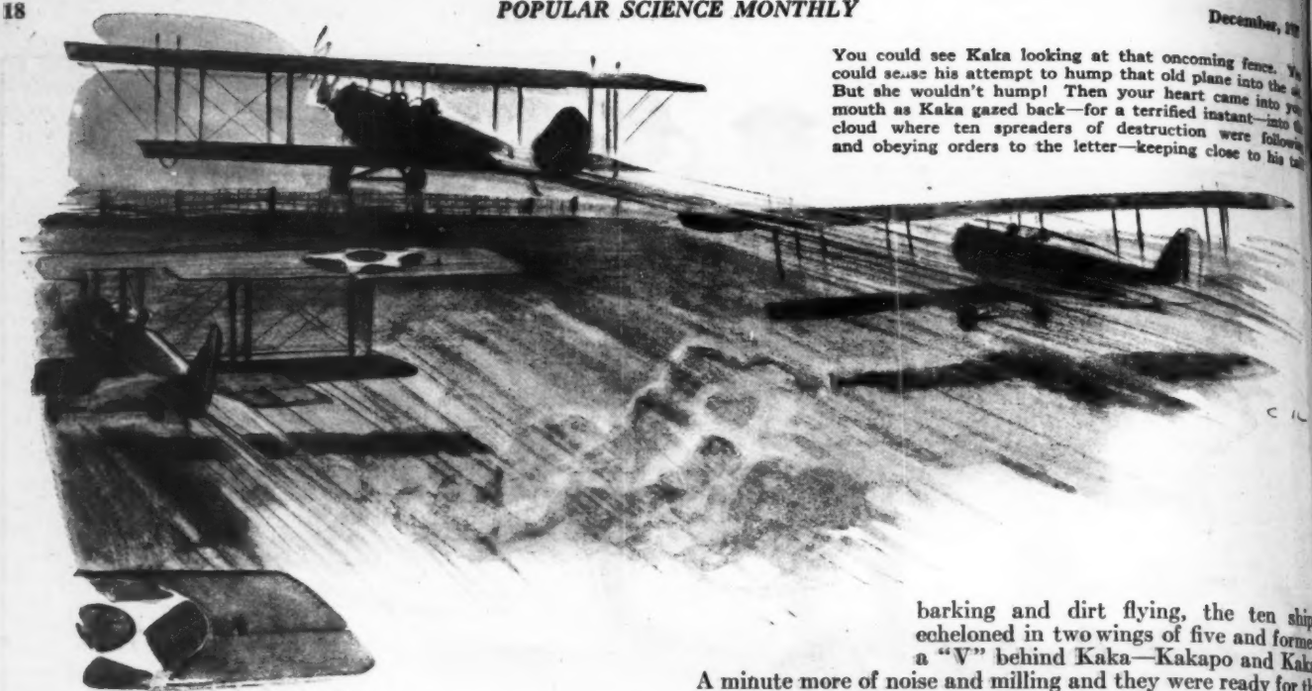
When the cadet class straggled out to the field for its ten o'clock session of air work, Kakapo Poe and Kaka Perlin were already on hand and waiting. Kaka, assuming a military air that seemed to come hard, called the cadets to attention and lined them up for a talk. Kakapo Poe, pacing back and forth with the dumpy, heavy heave of a frog that had eaten too much, resembled something that no maker of soldier clothing would ever present as a well-dressed, snappy officer. To be exact, Kakapo, in a very unbirdlike manner, broke the scales at close to three hundred pounds. He was *some* man. And plenty loud.

KAKAPO—after the cadet class had lined up—called Kaka to one side and gave him instructions. Whatever it was it had to be relayed.

"Says Kakapo to Kaka," Cadet Delano mused under his breath, "'You say that I said this.' Says Kaka to Kakapo, 'Yes, sir, I will, sir. I bow low, sir.'"

"Attention!" Kaka Perlin again called. The hard class came across with something approaching attention.

"The major," Kaka went on, "has had any number of recent complaints from farmers near this field. Also, several of the neighboring towns have called his attention to the fact that you cadets are flying too low. This must stop!"



You could see Kaka looking at that oncoming fence. Yo could sense his attempt to hump that old plane into the ai But she wouldn't hump! Then your heart came into yo mouth as Kaka gazed back—for a terrified instant—into th cloud where ten spreaders of destruction were following and obeying orders to the letter—keeping close to his tai

"Just a minute, Lieutenant Perlin," Kakapo called, and Kaka stepped back. The major spoke to him in a hard tone of voice. Then Kaka parroted:

"The major—if this low flying is repeated—intends that court-martial proceedings shall be taken against the offender. Now keep this in mind! No more low flying—do you get that?" Then, turning to the lieutenant in charge of the class, Kaka said, "That will be all, lieutenant . . . start your air work."

AT THAT minute, from here or there or wherever they come from, a news-weekly camera man appeared upon the field. He kicked the several members of his tripod in as many different directions and put the black box on top; he was set. It's a way they have. Next, with the camera ready for action, the circular-motion man ran Kakapo and Kaka to earth just as they were about to quit the field. The mighty two stopped to listen. Camera-click is cooingly sweet music; and news-reel stuff is a symphony in any man's life. Kakapo and Kaka were coming back.

Kakapo said something to Kaka, and Kaka saluted and came a-running. By that time, ten planes, each filled with cadets, were warming up on the line.

"Hold those ships!" Kaka yelled.

"Said Kakapo to Kaka, 'Hold those ships,' and they were held," Cadet Delano mused. The cadets idled their motors.

Kaka called the lieutenant in charge to one side. Then, going from plane to plane, the lieutenant told the flyers to fall out and line up for another talk. Cussingly, they did that thing.

"We're going to fly a close formation for this movie camera man," Kaka announced when the cadets had come to scratch. "With me, in the front plane and leading the flight, will be Major Poe. Now we want you cadets to do your best. We want a close, very-Scotch formation. Every man in his place all the time, from start to finish. That means that we will take-off—right in front of the camera—in formation. And remember—no flyer is to leave this formation except through motor failure. You get right onto my tail at the gun and stick there! To your ships."

When the cadets had once more climbed aboard their ten ships, Kaka turned to the lieutenant in charge. "Lieutenant," he said, "the major and I will use your plane."

"My plane," the lieutenant in charge said, "is very tail-heavy. That's why I use it. It's too tail-heavy for the cadets."

"But I'm not a cadet," Kaka said.

"No, sir, lieutenant," Kakapo chirped up with reverse parroting, "Lieutenant Perlin is not a cadet. We'll use your ship, lieutenant."

"Yes, sir. Certainly, sir," the lieutenant said. "It is all ready, sir. But very tail-heavy, sir."

"That will be enough, sir," Kakapo snarled.

"Quite enough!" Kaka echoed.

With Kaka piloting the lead ship, the ten cadet planes followed him afield. Out there in the dust and rank grass, with motors barking and dirt flying, the ten ships echeloned in two wings of five and formed a "V" behind Kaka—Kakapo and Kaka. A minute more of noise and milling and they were ready for the take-off. Standing in the cockpits of their plane, Kakapo and Kaka studied the line-up and were satisfied. Then, after the high-powered two had dropped into their seats and strapped up the safety belts, Kaka once more turned and held a dramatic hand aloft.

Ten watching cadets throttled and idled ten turning motors. Ten passenger cadets watched and waited; and Cadet Delano said to the cadet behind him, "Kakapo said to Kaka, 'You take me for a ride,' and Kaka said to Kakapo, 'Aye-aye, sir' and b'gosh he did." Delano was to fly one of the ships next to Kaka's rear.

The camera man waved his O.K. and started to crank. Then Kaka dropped his right hand and eased throttle to his motor with the left. Old Kakapo gripped the back cockpit's cowling with two hamlike, red hands and offered up an Army prayer. Ten cadets hit the ball and the flight was on its way. An army with orders!

Now, as a rule, a flight taking-off in formation does so more or less slowly. That is, the first plane gets under way and wins some speed before the next two—to right and left—make their start. Then, when these two get their tails up, the next brace comes along. In this way, with a group of eleven, the leader would have flying speed before the last of his followers were taxi-ing. And there'd be no danger—to the rear planes—because of the back-wash of those out front: on a take-off, disturbed air is not so good—not what the flight surgeon orders a-tall!

But, during the forming of the grounded "V," the word had passed from ship to ship to obey orders: "Remember what Kakapo told Kaka to tell you—keep close on Kaka's tail from the very start. Don't let any light show between. And never quit this tight formation under anything short of motor failure. Also, recall that there's to be no more low flying."

WHEN those eleven propellers went to work, a yellow cloud of Web Field's best dust went into the sky. For a few seconds all the planes could be seen; then, one by one, they went out in blurs. But the roar and the rumble of many wheels spoke of progress, and Kaka's equipment proved that the flag was still there. He, speeding on, bouncing up and off the ground, plopping back again, was headed for the west-side fence. And the high wire fence came in, fastly.

"It's the major's weight," the lieutenant in charge of cadets could be heard explaining, "that's holding that old crate on the ground. I told Perlin she was tail-heavy. And what I mean she *is* tail-heavy. Man, even when I'm flying her alone, it's an arm-breaker."

Web Field has a mile-long take-off; and that's a lot of runway. As a rule, a good pilot can pull the heaviest bomber off in less space than that. A mile! But it wasn't enough for Kaka.

Poor Kaka Perlin. Poor Kakapo Poe. You could see Kaka looking at that oncoming fence. You could feel him pushing the throttle against its ultimate "stop," and sense his attempt to hump that old plane into the air. But she wouldn't hump!

Then your heart came into your mouth and you felt sad as Kaka gazed back—for a terrified instant—into the cloud where ten spreaders of death and destruction were following and obeying orders to the last letter—keeping close to his tail. And more than that no man can do—keep close to the tail ahead.

And with them so close, Kaka could not "cut-his-gun" and abandon the take-off. That would mean several of eleven planes in one great smash-up. He had to go on, crowd the power and pull her out of danger. It was a man's-size job of frantic boot-strapping!

WELL, to this day, they'll tell you that Kaka taxied under that fence. But it's just as easy to tell the truth here—for once—so we'll say he went over. But it was only through force of character, or, maybe, because Kaka and Kakapo were born to die at the end of a rope and not in a plane crash. And, once they had cleared the wire, down the plane sank again.

And up, over and down went the ten following planes.

Now, with the dust out of their eyes, the cadets could more easily see and follow their leader. All eleven planes were off the ground—off and that's all. But the well-ordered flyers came in closer. Yes, the first two behind Kaka—one on either side—came in until the tips of their wings were pretty close to Kakapo's shoulders. And the old boy, showing the first sign of returning life, waved them off. Thinking that the major was being friendly, the flyers waved back. They came a little closer, if possible. To say the least, it was a beautiful piece of formation flying. Beauty, however, is pretty much a matter of mind: Kakapo and Kaka were not in the frame to appreciate it. Strange, eh?

Kaka's plane, as time went on, showed little sign of improvement. Its tail seemed to be pointing toward the earth in a manner suggestive of very bad omen; as if it were trying to tell Kakapo and Kaka—"That's where we're going, and soon!"

No kidding, that old ship was loggy. And it was just making enough headway to remain a-wing. It stalled. It fluttered. It did this and that and all the things a piece of air equipment should not do; and Kaka — poor Kaka!—tried everything in the book. Everything but the right thing—he failed to jettison Kakapo.

When the general landed and spotted the flight you could see he was not overjoyed with what he was witnessing

Beyond Web Field, in the direction of the flight, there are miles and miles of dismal cypress swamp. The cypress growth is not high, but it is plenty thick and mean. Underneath, it is also plenty wet. With such a wet aspect, below, Kaka could hope for no succor in the immediate future. Miraculously—and with a fool's dash of luck—Kaka managed to clear the first of the cypress trees and ride safely in above the wilderness. Then, crowding closer and yet closer, the brave boys behind came in nearer and tried to ascertain just what was keeping Kaka's tail down in such a laughable manner. From the distance, as all onlookers agreed, the eleven planes were now so well bunched that it looked like one single plane with a sweep-back to its wings.

Kaka, finding that the flying of that plane was "in the bag—or the book" fell to thinking. He thought that the most he could do was to work this wild bunch around toward the field in a large circle. And, in this way, by winging up from the east, he might get a chance to shoot in for a landing. So he wished on a little left-rudder, pushed over on the heavy control stick, and hoped for the best. Through the tree tops, and always true to their leader, the cadets—perhaps to avoid loneliness—snuggled just a bit tighter.

The snuggling bothered Kaka and it bothered Kakapo. And Kakapo, having more time for such manifestations, waved madly. As a man, the cadets waved back. There is nothing like being on good terms with the C.O., and cadets are never uppish.

At about this stage of the game, a small spot in the northern sky grew larger and took on the appearance of a visiting plane. Ten minutes later—when Kaka had completed about half of his great circle—the spot that was a visiting plane came in and made its landing. The visitor was a high-ranking general who popped in now and then for an inspection. The general, noticing that all hands were looking at something other than a high-ranking general, became curious. He, standing upon his tiptoes and wondering, finally spotted the flight moving through the south-side trees. And the general, being quite sufficient unto himself, said nothing. The few who might have spoken to a general were not there, but in the lead plane; so, asking nothing, the big boy learned less. But, to see and study him, you'd know that the big boy was not overjoyed with what he was witnessing.

Twenty minutes later, several miles east of Web Field, Kaka had finished his great turnabout. He cased that ship into the west, sneaked around a few extra-high trees, and hoped some more. Below Kaka, and looking wilder than ever, old Kakapo stared longingly up to the front cockpit and also hoped.

When Kaka approached the east fence of Web Field—and this is the truth in a strange place—he flew under the telephone lines on the state highway! And ten cadets followed him when he did so. And all the watchers held their breaths. All but the general; he held everything but his breath.

Now, coming to the high east-side fence, Kaka and Kakapo wished, hoped and prayed a little harder. They cleared the wire—and the awful ten flea-hopped behind them! Then—and you could hear Kaka sigh half a mile away—he cut his power and felt for the ground. But he felt not long; with that weight in the rear cockpit, the ground came right up and smacked them!

And the other ships, and all of them together, cut their power and landed as one.

When the ground came up and slapped Kaka's plane, the old ark cracked up like something that all Humpty Dumpty's men would be surprised at—there was nothing of that plane left but the number. The next two behind hooked wing tips into the crash and ground-looped in a swirl of dirt and dust. Then the next, and the next, did likewise. Of the eleven all but four had major injuries. And the field was a madhouse. And the maddest man in the madhouse was one visiting general.

SLOWLY, out of the dust and commotion of battle, Kaka and Kakapo could be seen to rise, feel their spare parts and get set to go into action. It was going to be a hard war on cadets.

But the general's presence became known. Kakapo, followed by Kaka, were bowing and scraping as they came toward him.

"General," Kakapo started to say. "General ———"

"Not a d—— word!" the general bellowed.

"But let me explain, General. We———"

"Not a word, Major Poe! I saw this whole show with my own eyes, Poe. And a disgraceful display of low flying and order-breaking it was! The thing that Air Corps is fighting hardest—low flying—and you, a major, leading such a troupe of outlaws as this!"

"But, General ———"

"Cut it!" the general barked. "Put it in your report; I've seen and heard enough!"

The general called his pilot and sailed away.

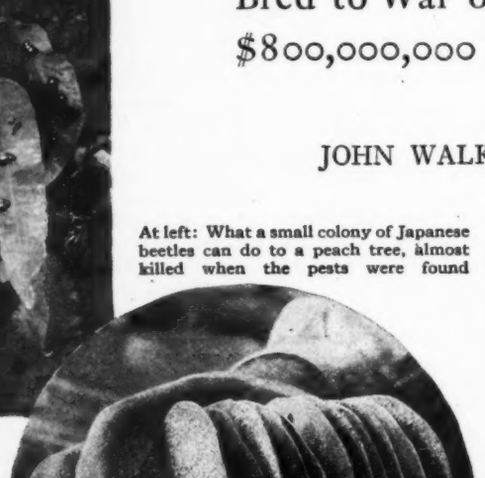
"And Kakapo said to Kaka, 'You tell the bad cadets not to fly too low,'" Cadet Booth Delano repeated at mess that noon. "And what did the cadets do? I ask you. Did they fly too low? No—is the correct answer—they flew *one* low, and that one was Kakapo. All of which checks the well-known truth that a kakapo is a New Zealand parrot, a talking parrot which has wings but does not fly. At least not high; not high enough to be called *up*."

Fighting Bad Bugs *with* Good

Millions of Insects Imported and Bred to War on Pests That Cause $800,000,000 Yearly Loss in U. S.

By
JOHN WALKER HARRINGTON

At left: What a small colony of Japanese beetles can do to a peach tree, almost killed when the pests were found



Millions of eggs of coddling moths, walnut and apple tree foes, are glued on these cards; then the parasites that kill moths are allowed to lay eggs on them. The cards are mailed by Stanley E. Flanders, Ventura County, Calif., entomologist, to any moth-infested area, where the parasites hatch, multiply and war on the moths

WITH an armful of heather she came down the gangway of an ocean liner, just berthed at a New York City pier. The flower of the Scottish moors matched her sports suit—and she knew it. At sight of her a young man in green stepped eagerly forward and raised his fedora hat.

"I'll relieve you of the heather," he smiled.

"Well, perhaps I might spare just a sprig," she said, "but haven't you made a mistake? We don't really know each other, do we?"

"Permit me to introduce myself," he returned pleasantly, pointing to one of his coat buttons. "Inspector Federal Plant Quarantine. And if you don't mind, I'll take all of it. No foreign plants, shrubs or flowers can be brought to this country without special certificates."

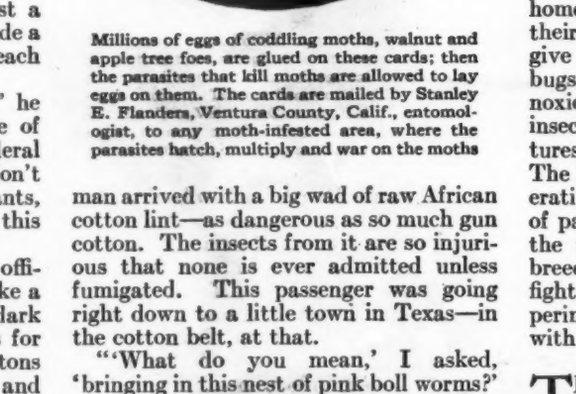
At every port are stationed such officials. Their uniform looks so little like a garb of a service, that without their dark green badges they might easily pass for returning tourists. Their coat buttons bear the eagle with outspread wings and the initials "U. S. D. A.—F. H. D." for United States Department of Agriculture —Federal Horticultural Board. These "Mister Greens," as they are called, see that no plants, seeds nor bulbs are admitted except under safe conditions. They are the patrols of the bug blockade —for as stowaways in flowers and the like come insects which lay waste the country. Even a branch from some shrub in the Argonne, brought by a returning American Legionnaire, may carry enough eggs to start colonies of bug guerillas.

"THERE is no limit to the harm which can be done by bringing harmful insects in plant keepsakes picked up abroad," said a "Mr. Green" the other day. "Were it not for the customs inspectors, who tip us off whenever they find any growths in baggage, we would not be able to do as well as we do. Several weeks ago a colored man arrived with a big wad of raw African cotton lint—as dangerous as so much gun cotton. The insects from it are so injurious that none is ever admitted unless fumigated. This passenger was going right down to a little town in Texas—in the cotton belt, at that.

"'What do you mean,' I asked, 'bringing in this nest of pink boll worms?'

"'I didn't mean no harm, Mr. Captain,' he explained, 'I brung it for my toothache.'"

Had Uncle Sam not waited until 1912 to institute this ban, the loss of crops through insect pests would not now be more than the entire budget of the Federal Government. The damaging insects are practically all aliens. Some came with hawthorn from ancestral homes in England, or slipped in on linden shoots from Germany, or even in shamrocks nestling in a bit of the "ould sod." One of the worst pests was the gypsy moth which an astronomer brought from Europe in 1869 with the idea of crossing it with the silkworm to furnish raw material to our mills. Some of the caterpillars of the gypsies escaped from the scientist's place at Medford, Massachusetts, and in a few years most of the trees in the Bay State were minus leaves.



How the larva or worm of the coddling moth works. At the right we see where the larva entered the nut and at the left its devastation on the meat inside

Foreign insects do great damage here because they find conditions more favorable than on their native heaths. Climate, soil, more abundant vegetable food —all are factors. The chief cause of their abnormal increase, however, is the absence of the natural enemies they had at home. Birds in America may turn up their bills at them; our toads and snakes give them the go-by. Only the war of bugs among themselves keeps down the noxious population. The worst enemy of insect pests are the almost invisible creatures, the parasites, which feed on them. The Federal Government, with the coöperation of the states, is importing millions of parasites from the native countries of the undesirable insect immigrants, and breeding and training native parasites to fight the invaders. Once a doubtful experiment, this plan of fighting bad bugs with good is now recognized as effective.

THE war on the Japanese beetles probably affords the best example. These pests first appeared in noticeable numbers in 1916 near Riverton, New Jersey, having come, Government experts believe, on the roots of iris from Japan. Half an inch in length, with bronzelike wings and green bodies, they might have passed for some harmless American variety. They began their first offensive after digging into an area of only three hundred acres. They now infest 6047 square miles, including all New Jersey and parts of Pennsylvania, Delaware, New York and Connecticut. They consume fruit, blossoms, flowers, shade tree leaves, shrubs and many vegetables.

To check this invasion, the Department of Agriculture organized a campaign, operating through its units the Bureau of Entomology and the Federal Horticultural Board and with the help of the states concerned. The chief of staff, veteran strategist in insect

wars, is Dr. L. O. Howard, head of the Bureau of Entomology. The field headquarters is the special Japanese Beetle Laboratory at Riverton, with L. B. Smith in command. Another station was set up in the Bronx, New York City, with L. B. Zimmer as executive officer.

All kinds of methods were tried to reduce the unwelcome visitants. One expert invented a sweet-scented mixture with which he atomized foliage. The beetles swarmed over the fragrant leaves and were killed by a poison spray. But this method was too costly.

Never was a quarantine more thoroughly organized and enforced, as the writer, who has a small farm at Tappan, New York, on the north line of the "regulated area," can testify. On every road last summer were "Bug Cops," as they are called. They permitted no loads of produce, trees, shrubs, earth nor manure to move without certificates that such had been examined and found free of the pests. Violations were punished by fines of $500. Sharp-eyed young men, embryo entomologists, the "Insect Scouts," searched fields, gardens and parks, bringing beetles into headquarters for examination. Road signs warned citizens of the dangers of the pests.

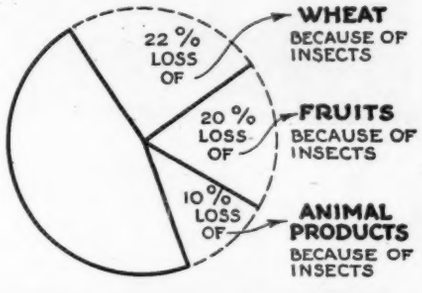
If Japanese beetles did not fly, more headway could be made against them. The females fly thirty miles and lay fifty or sixty eggs apiece, which before many months produce new colonies of the pests. What is needed is a pursuit plane for each one, such as are now going into commission by the million—the parasites from Japan which are already showing their deadly work.

DR. HOWARD sent an expedition to Japan in 1920 to study the habits of the invaders and to find out what their enemies were. The Japanese experts were surprised to hear of the havoc in New Jersey. The insect had done no great damage at home. For days the American scouts could not find any of the bugs. Finally they employed two hundred women and children to help them, giving prizes and bonuses, and at last got what they sought—beetles which had been attacked by parasites.

The first parasite found was a small fly, which chases the beetle until she tires it out, and then lays fifteen to sixteen eggs on it. Maggots hatched from the eggs bore into the pest, kill it and then breed. The American entomologists sent to Riverton beetles on which eggs had been laid by eight kinds of parasitic flies, and also a wasp which feeds on the beetle and a large beetle of prey which fights its Nipponese bad brother, claw to claw, and eats him.

Smith, in charge of the Riverton laboratory, says five varieties of the newcomers were multiplied and turned out in the open air in colonies to attack the enemy. The most effective so far are the Tiphia wasps, for of the beetles caught near the laboratory twenty percent were infested by these parasites. Thousands of these wasps have been effectively transferred to various parts of New Jersey.

Corn bins where moths are raised to provide food for parasites being bred to war against moths in the fields. As the moths emerge they are collected by an ordinary vacuum cleaner



Illustrating the percentage of losses of commodities in America, due to insects. The total is $800,000,000 yearly; fires total $143,600,000

On the boring line are the larvae of the Dexia and the Prosena flies. The Centeter flies have now a spread of seventy-five square miles.

Despite progress against the Japanese beetle, the situation is still acute. Dr. A. L. Quaintance, Associate Chief of the Bureau, is much concerned over ravages of the beetles in the cornfields. It would be a serious situation if the bugs from Japan spread westward in 1928 and joined the corn borers against which the Government has another campaign, described in POPULAR SCIENCE MONTHLY for September.

Coming as stowaways in broom corn from Hungary and Italy received near Rochester, New York, in 1909, the European corn borers have pillaged thousands of farms in parts of New York, Ohio, and Ontario and beyond.

Against the corn borer the parasites have won medals for valor, especially the "Rileys," as the scouts call a species first described by a scientist of that name. To keep generations of borers yet unborn from leading the "life of Riley," this parasite buries her eggs in those of the pest. They are among the seven American varieties which war on the maize manglers, while the Government has imported eleven others.

Taken all in all, six kinds of parasitic flies have pretty well defeated the corn borer all through Massachusetts. The army of 1,187,000 foreign parasites sent against the borers in New England caused a heavier casualty roll than the native parasites did. The corps of 225,000 recruited overseas and assigned in 1926 to nine localities in the Middle West are multiplying and becoming effective.

L. H. Worthley, Administrator of Corn Borer Control, reports many European parasites and some from India and Japan sent against the borers.

Thanks to the parasites, much of the depredations of the gypsy moths have been stopped. The coming of the brown-tailed moth from Europe in 1897, of course, made things worse. That efficient parasite, Compsilura, recruited in ten European countries and in Japan, has kept these nuisances within bounds. Since its introduction in 1916, according to Julian J. Culver, assigned to fight gypsy, brown-tailed and white tussock moths, those pests have practically disappeared. It has also nearly exterminated the celery worm, the cabbage worm and the fall web worm in eastern Massachusetts.

THE pink boll worm, a native of India, which came by way of Egypt and Mexico to Texas, is very destructive in the American cotton belt. Its worst natural enemy is a mite, which would be worth encouraging more, but for its habit of biting human beings. Forty-five kinds of parasites, of which twenty-three were imported, assail the Mexican boll weevil.

All who have gardens and orchards know the San Jose scale, killed by a tiny beetle known as the lady bird, or ladybug, whose importation was described in POPULAR SCIENCE MONTHLY for last October.

The insect foes of insect pests live on their kill. They do not feed on vegetation; if they did they would be as dangerous as the enemies they are sent against.

When its strength is sapped by borers, corn is less able to resist the grain disease called smut. Miss Marion Griffiths, a U. S. plant pathologist, comparing good and diseased ears

Marconi—*the* Father *of* Radio

Inventor Who Amazed World with Transocean Signals in 1901 Now Predicts More Marvels

By ALDEN P. ARMAGNAC

ATOP a bleak Newfoundland cliff overlooking the December Atlantic, a young man sat at a queer-looking set of instruments. Wires and coils were grouped about him, while above the small building a kite darted and plunged, carrying aloft a thin wire. Telephones were clamped to the young man's ears. Then came three clicks that have made world history.

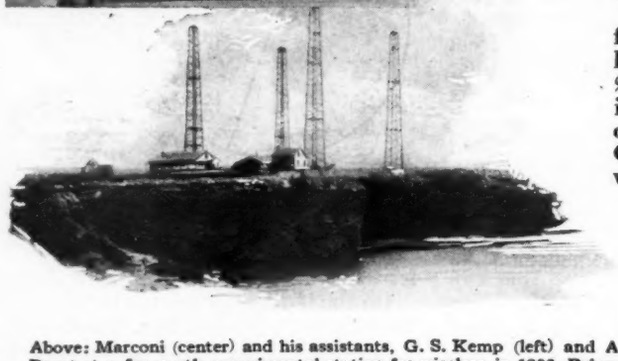
"Do you hear anything, Mr. Kemp?" asked the young man as he passed the receivers to his assistant.

"Yes," was the reply, and Guglielmo Marconi knew that he had heard the letter "S" hurled by wireless across two thousand miles of ocean from Poldhu, England.

Today, twenty-six years since a wireless wave's first trans-Atlantic hop, Marconi finds us living in a world of radio. Broadcasting stations entertain us and the people of fifty-six other lands. Eighteen million radio receiving sets, our Department of Commerce tells us, bring music and speeches of famous men to 90,000,000 listeners the world over. The other day a photograph was dispatched by radio to far corners of the earth. Television is being perfected, and even radio power seems just around the corner.

Even as Marconi laid down his receivers after the first transocean signal, his mind was dreaming of these newest radio successes, but he knew then that the world would doubt his first achievement. It was not until three months later, when Marconi received whole messages on a ship taking him from England to Canada, that the last doubt disappeared. From that time on, progress of radio was rapid. "Wireless telegraph" became "wireless telephone," then "radio" as we know it. Broadcasting stations came into being; then "beam wireless," modern wonder. Now radio waves steer airplanes and detect hidden metal ores.

DESPITE his achievement, it was not with Marconi that the idea of signaling without wires originated. In 1867 Professor James Clerk-Maxwell, British physicist, based a theory of transmitting electric waves upon earlier experiments of Michael Faraday. Twenty years later Heinrich Hertz in Germany generated by means of an electric spark gap waves that could be measured. Marconi developed Hertz's invention into a device of practical use.



Above: Marconi (center) and his assistants, G. S. Kemp (left) and A. Paget at a far north experimental station for wireless in 1903. Below: Glace Bay, N. S., station, which received the first complete messages

Legend has it that Marconi, at nineteen, then a student at Bologna, first thought of wireless because his sweetheart's Irish mother forbade their communication. All he has ever said is, "I wanted to communicate with some one with whom I could not otherwise communicate."

Marconi's first wireless patent, obtained in 1896, embodied a "coherer,"—long since replaced by vacuum tubes—that used wireless waves to render a tube of iron filings a relay for electric currents, and with it familiar coils and instruments theretofore used by electrical engineers.

MARCONI went to England in 1896 and set up experimental stations and in 1899 sent a wireless message across the Channel to Boulogne in France. Three years later he came to America to continue experiments and by 1901 twelve ocean liners were equipped with his wireless system.

In August, 1901, the first trans-Atlantic wireless station, with twenty 200-foot masts carrying its aerial, was nearing completion at Poldhu, Cornwall, when it was wrecked by a storm.

"I was extremely disappointed," Marconi said, but by the middle of November he had erected a makeshift aerial—sixty copper wires converging in fan shape at the bottom, suspended from a triangle of cables hung in the air. Again Marconi set off for America.

Inconspicuous press notices told of his arrival, in contrast with the columns that were devoted to him when he came to this country last fall. Marconi, wise for his age—he was only twenty-seven—knew that if he announced his purpose to span the Atlantic he would be a laughing stock.

On Signal Hill, overlooking St. John's harbor, Marconi set up his apparatus. He must get a wire, a receiving aerial, into the air. A balloon with the first one was carried off by fierce winds. A huge kite bore the second up 400 feet and defied the elements. Marconi cabled the operators at Poldhu. They were to send the letter "S," three dots or clicks in the Morse code.

At half past twelve on that historic (*Continued on page 138*)

Guglielmo Marconi, wireless inventor (right), who received first trans-Atlantic signals, and his assistant, G. S. Kemp (left), who confirmed them, show first crude type of receiver to Viscount Wolmer

Drawings by Lui Trugo

The Human Mind Craves Wonders—

So *the* Quacks Get Rich

Magic Collars, Electric Belts, and Mysterious "Cure-Alls" Lure Thousands, Who Might Have Real Wonders for the Asking

By MORRIS FISHBEIN, M. D.

FROM the earliest times there have been miracle men because there have been men who craved miracles. In time of disease, particularly of incurable disease, the human being apparently loses all sense of reason and is ready to rely on incantation and prayer. Figuratively and literally, he grasps at any straw. The motives of those who sell devices for the relief of pain or for the cure of disease do not in such times concern him. He craves wonders and is easily deceived. For this reason the story of quackery is a never-ending tale.

As rapidly as new discoveries appear in any field of science, inspired quacks adapt those discoveries to their exploitations. In 1796, electricity was much more of a mystery than it is today. Benjamin Franklin had flown his kite and the Leyden jar had been described in Holland. Everyone was interested in electricity and talking about its mysterious powers, but few actually knew anything at all about it. Elisha Perkins, born in Norwich, Connecticut, and graduated as a physician, developed on the theory of electricity two little metal rods, one composed of copper, zinc and gold and the other of iron, silver and platinum, although it has been asserted that they were probably just brass and iron. With these little rods three inches long, he claimed disease could be drawn from the body, particularly if the Perkins' tractors were drawn downward; drawing them upward might intensify the disease. They cost perhaps a shilling apiece to manufacture, but they sold for five guineas.

Perkins' tractors took the country by storm, exactly as did the visit of Emil Coué. Testimonials were secured from the chief justice of the United States and many other notables. George Washington purchased a set of the tractors for the use of his family. Eventually the tractors were taken to England by Benjamin Perkins, son of Elisha, and there the discovery won equal success. Finally two English physicians made a pair of tractors out of wood and fixed them up to resemble the authentic specimens. With these they produced cures as remarkable as those produced by the Perkinsonian tractors. When the fact was made known, tractorism disappeared as a science for the healing of disease.

The modern reader will laugh at the people that purchased the Perkins tractors, but today in almost any drug store one still finds for sale heel plates to be put into the shoes. One of these is made of copper and the other of iron, and the chart proclaims in glaring letters that by this means the electricity in the body is grounded and rheumatism disappears. Any druggist will tell you these are bought in equal quantities by economical Senegambians or prosperous bankers.

Perhaps the greatest quack of all times was Albert Abrams, of San Francisco, who departed this life in 1924. His story develops like that of Elisha Perkins.

DR. FISHBEIN is widely known as an interpreter of modern medical science. He is editor of the *Journal of the American Medical Association*, also of the health magazine, *Hygeia*, and is the author of numerous popular articles and books on medicine and health.

Abrams was a legitimate practitioner of medicine, the graduate of a good medical school and he had studied abroad. When he returned to San Francisco his ability was recognized by an appointment to the position of teacher of pathology in his alma mater, and by election to an office in his medical society. But the returns of a young practitioner or a teacher of pathology are not great, and Abrams cast about for means of increasing his income.

After the Civil War there appeared in the United States the revelation of Andrew Still that disease was caused by a misplaced bone in the spine which, pressing upon the nerves emerging from the spine, set up degenerative conditions. No doubt, a misplaced bone will actually do this, but anyone familiar with the fundamental sciences that make up the modern practice of medicine will realize the ridiculous nature of the claim all disease is caused by such displacements. Nevertheless, this simple hypothesis achieved great vogue in the United States between 1870 and 1900, and is only now beginning to lose ground seriously. Not long after Andrew Still began his teaching, he was visited by D. D. Palmer of Davenport, Iowa, who was at that time a traveling practitioner of magnetic healing. Palmer took over largely the conceptions of Andrew Still and from the hybrid of magnetic healing and osteopathy developed his school of chiropractic.

That class of the community for which Barnum showed such a preference is ever ready to purchase an electric belt to relieve rheumatism and liver trouble, restore strength, and whatnot

THE popularity of these short cuts in medicine resulted in the development by Albert Abrams of a system of practice known as "spondylotherapy," the term "spondylo" coming from the Greek word for spine and not from the better recognized "spondulix," referring to the coin of the realm. Briefly, spondylotherapy consisted of tapping the spine repeatedly and persistently with a rubber hammer until the patient became convinced that something had been done for his illness. With this conception, Albert Abrams developed a medical society, a medical periodical, a graduate school, and all of the other paraphernalia of medical promotion. Perhaps because he was not yet ready to go as far as Palmer and Still, spondylotherapy failed to bring him either the position or the returns that he sought.

Immediately after the beginning of the twentieth century, however, there came upon the scene a newer knowledge of electricity associated with the invention of the wireless telegraph and the radio. People began talking about tubes, waves and electrons. Just as in the time of Benjamin Franklin, the period was ripe for exploitation of this knowledge in the field of quackery, and to such exploitation Abrams devoted himself. In his technic, a drop of blood was secured from the patient and placed upon a piece of filter paper, the latter was put into an apparatus called a dynamizer, which was in turn connected with a rheostat dynamizer from which wires passed to a vibratory rheostat, which was finally connected with a measuring rheostat, from which a wire passed to the forehead of some available subject.

Here was a scheme to bring the flame of envy to the cheek of Rube Goldberg. Bear in mind that the subject was never even slightly related to the person who was ill. The subject faced west in a dim light, an obliging assistant turned the switch, and the practitioner of the electronic trade thumped on the abdomen of the subject. According to Abrams, the varying areas of dullness in the subject's abdomen indicated various diseases in the person contributing the blood, and these diseases were usually those most feared by man, tuberculosis, cancer and syphilis.

Abrams' device consisted of an apparatus for treating people with appropriate vibrations. He claimed even the ability to tell the religion of the person submitting the blood, and to diagnose disease by his methods from the handwriting of those long since dead.

Abrams leased his apparatus, exacting a contract that it would not be opened by the purchaser. Of course, curious investigators did open the boxes. It was found that the Abrams followers were inserting electric resistance into a circuit which could not oscillate, and therefore had no vibration frequency. Competent physicists who investigated the apparatus found it a jungle of electric wires violating all the rules of sound electrical construction.

ON HIS death, Abrams left an estate of more than a million dollars made in a few years, but as with most peculiar methods of treatment, his cult died with him.

Soon afterward emerged one of the most romantic of medical quackeries, the I-On-A-Co, a device developed by one Gaylord Wilshire in Los Angeles and satirically designated the "magic horse collar." Certainly the early experience of Wilshire in the exploitation of socialism, including his magazine and gold mines on the installment plan, should have caused anyone to hesitate regarding his newer ventures. But the public that paid Abrams is equally ready to pay any one else for ingenuity.

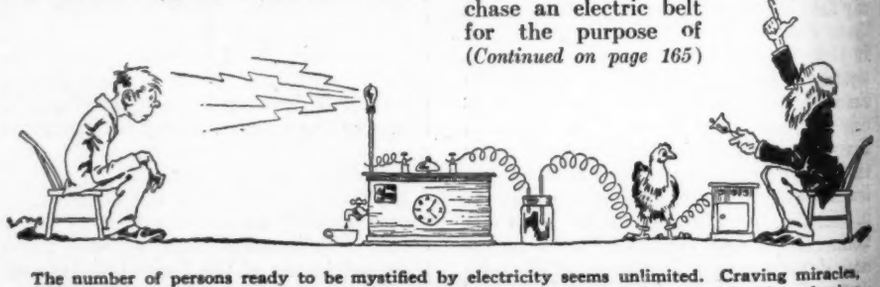
I-On-A-Co is a collar of insulated wire, including about six and a half pounds of twenty-two-gage, worth about $3.50. The coil, eighteen inches in diameter, is fitted with a plug so that it can be attached to an electric light socket. Inside the first coil is another coil, including about one pound of eighteen-gage wire, worth about sixty cents, its two free ends being attached to a miniature light socket containing a small flashlight bulb. When the larger coil is attached to the electric light current, a weak fluctuating magnetic field is generated within it so that the light in the small coil will light up when the latter is brought into relationship to the large coil.

THE person suffering with any disease is supposed to place the collar around his neck, his waist or legs. Wilshire claims it will cure practically all human ailments and restore gray hair to its original color, the magnificent result being achieved by the fact that the device magnetizes the iron in the blood. Anyone with even a minimum knowledge of physiology knows that the iron in the blood is organic and not inorganic iron. There is about as much chance of magnetizing the iron in the blood as there is of picking up a piece of spinach with a magnet. Nevertheless, Wilshire has been able to sell thousands of these devices for $58.50 cash, or $65 on time payments. He has secured testimonials from hundreds of people alleged to be suffering with arthritis, heart disease, diabetes, paralysis, cancer, Bright's disease, asthma, pernicious anemia, baldness and mental derangements.

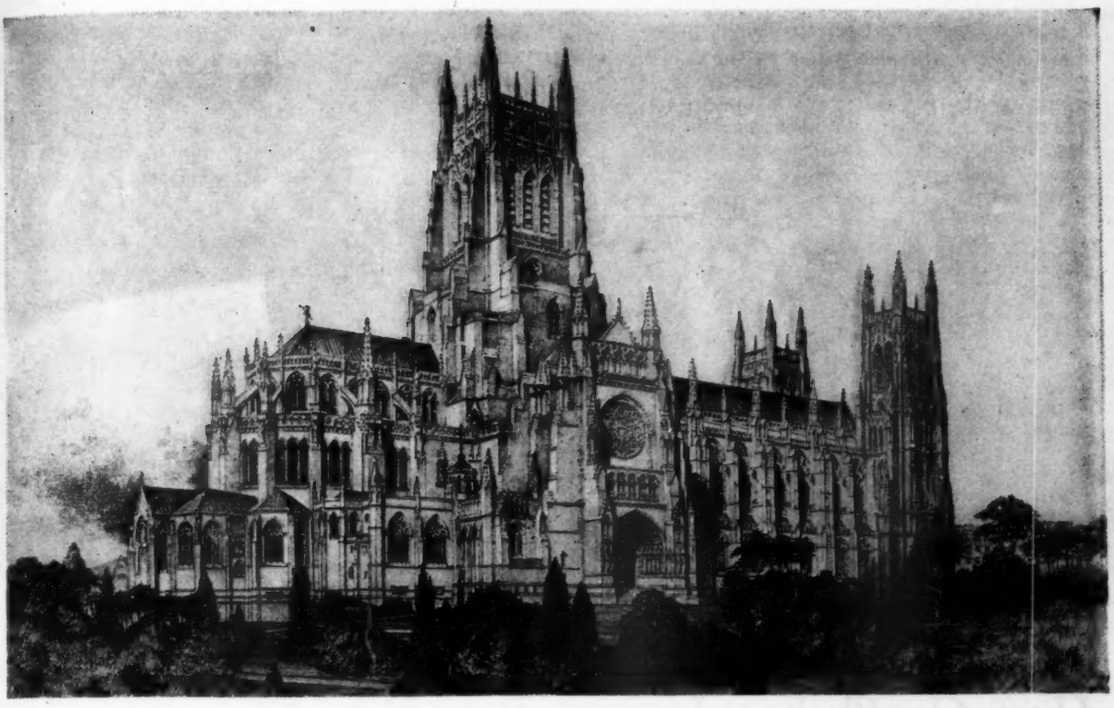
Testimonials are not difficult to get for anything. It is reported that in one promotion campaign several quite distinguished ladies sold their portraits to a cold cream company for $5,000. The renowned Jack Dempsey for a consideration permitted the statement that nuxated iron permitted him to triumph over the once renowned Jess Willard. When "sanatogen," a combination composed of ninety-five percent of cottage cheese and five percent of glycerine phosphates, was offered to the public as a marvelous tonic and a general "cure-all," testimonials were easily secured from artists, statesmen, tragedians, and litterateurs. The ordinary testimonial is hardly worth the paper it is written on.

In the wake of the notable quackeries that have been described comes a flood of similar quackeries promoted on a smaller scale. That class of the community for which Barnum felt such a special preference is ever ready to purchase an electric belt for the purpose of

(*Continued on page 165*)



The number of persons ready to be mystified by electricity seems unlimited. Craving miracles, health seekers sit spellbound before Rube Goldberg contraptions and strange jungles of wires

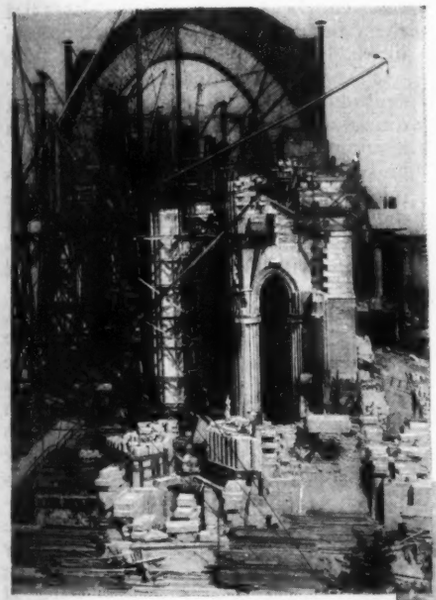


An architect's drawing of the Cathedral of St. John the Divine, third largest cathedral in the world, as it will appear when it is completed

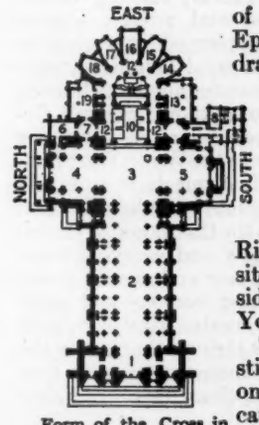
Fifty Years to Build Church

Engineering Problems Mastered to Make the Cathedral of St. John the Divine Stand for 2000 Years, a Mighty Pile of Solid Masonry Unenforced with Steel

By
JESSE F. GELDERS



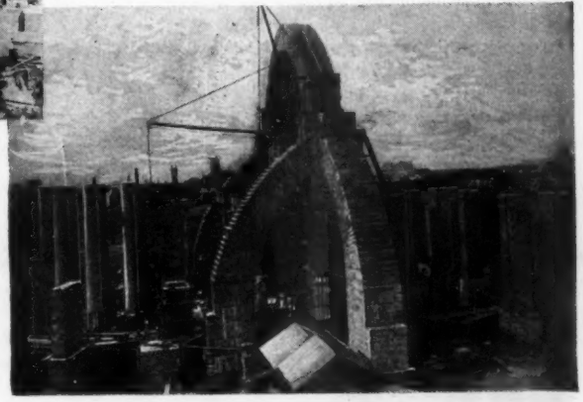
Building on the cathedral today. One of the entrances now under construction



Form of the Cross in cathedral ground plan

HUNDREDS of spectators lined the way, watching the laborious progress of twenty-four horses, harnessed to a single load, straining against their collars.

Their burden was a granite column, thirty-eight feet long, six feet in diameter. It was carried low, between huge pairs of wheels, specially made nearly three feet wide so as not to cut too deeply into the streets. Yet before the destination was reached, one of them had crunched through the surface and caved in a storm sewer. It was gotten out, and the outfit moved on.



Early work on the cathedral. First pillars and arches being erected in 1905, fourteen years after construction was begun

The ponderous stone was a section of one of eight great pillars for the sanctuary of the Protestant Episcopal Cathedral Church of St. John the Divine. It was twenty years ago that that odd procession made its way from a Hudson River pier to the site on Morningside Heights, New York City.

Today work is still going forward on the unfinished cathedral. It is to be the third largest in area in the world. Only St. Peter's in Rome, and the cathedral in Seville, Spain, will surpass it. Its cost will be about $20,000,000.

Planned in the form of a cross, when completed it will offer an observer in the nave, or long arm, an unbroken vista of 500 feet, about two city blocks, to the pillars and chapels at the farther end.

At the crossing, where the two arms intersect, the ceiling will be 235 feet above the floor. A moderate sized church might be placed there, steeple and all. There are seventeen and eighteen story buildings in New York which could occupy the space, and never touch the ceiling or wall.

The time element alone makes the cathedral out-

(*Continued on page 171*)

Getting Ready for the Next War

Dirigibles, tanks, bursting bombs and flares in night maneuvers in Maryland give vivid picture of the next war

Amazing Guns Hit Aircraft in the Dark and Hurl Huge Gas Shells—Invisible Rays Exterminate Whole Armies—Submarines Launch Dirigibles and Bombers

By GEORGE LEE DOWD, Jr.

CRASHING, rending chaos! Flame and smoke, sinister vapors pierced by searing invisible rays! Overhead, myriad monster airplanes hurling bombs of hitherto unknown power! Beneath, tens of thousands of cannon firing half again as far as in the World War; hundreds of thousands of machine guns and automatic rifles spraying bullets a third farther than in 1918; thousands of charging tanks, swift now and carrying more and heavier guns; new and deadly gases, incendiary shells and bombs—and amid this inferno he has created, tiny man, pulling his bright new strings that cause the death dance of his monster, the next war.

Stanley Baldwin, Great Britain's Prime Minister, says:

"One more war in the West, and the civilization of the ages will fall with as great a shock as that of Rome."

Marshal Foch, of France, says:

"The next war will be a war of machinery rather than of flesh."

SO SAY many others, here and abroad. They are, to be sure, those who are specializing in producing materials for that kind of war—and are known as the "Scientific War Men." Some call them enthusiasts, devoted to the bright images of scientific achievement created by their own devotion. In this country, particularly, although the average American is an "inventive, mechanical cuss," the leading all-around soldiers of the Regular Army warn against taking their predictions too literally. Yet majority opinion among those thinking, reading, writing about the next war is that it will be scientific, and horrible, and destructive beyond our knowledge. To which most Americans now, nine years after 1918, may respond:

"Well, what of it? It can't touch us."

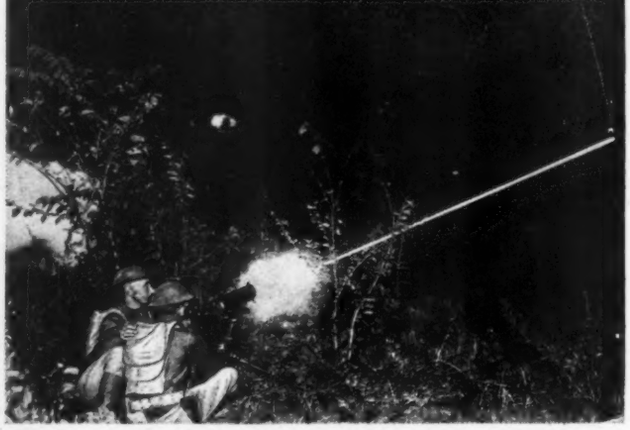
But science has destroyed our safety. That is the conclusion of quite a few scientific war men in this country. Lieutenant Maitland said the flight to Hawaii demonstrated that the United States was vulnerable to air attack. Major Gen. Mason M. Patrick, Chief of the Army Air Corps, said both Army and Navy knew this and "the oceans are shrinking."

Admiral W. S. Sims says our ports at least can be bombed by airplanes brought across the ocean by airplane carriers. They are swifter than battleships, and each can bear about fifty airplanes that carry bombs from 2,000 to 4,000 pounds in weight.

There was exhibited at the Sesquicentennial in Philadelphia, even if it didn't work, an airplane to be carried in a submarine. In the next war there will be supersubmarines, 400 feet long, carrying heavy guns, that can cross either ocean, raid coasts, go home, refuel and refit, and do it again! Such supersubmarines will have crews of a hundred officers and men.

Air attack will be mercilessly swift. Fleets of bombing airplanes will drop upon great cities bombs of a ton or more weight, carrying high explosives, perhaps gas, perhaps insidious disease germs. In London they are studying now means to protect the population from gas attack from the air, and are considering gas-proofing parts of the subways.

No wonder, for Captain B. H. Liddell Hart, British military writer, says French airplanes could drop a greater weight of bombs on London in one day than did the Germans in the whole World War.



Machine-gun practice at night with tracer bullets which burn in transit, enabling the gunner to direct his fire and find his mark. The picture shows a stream of bullets glancing off a target at Fort Des Moines

GENERAL VON ALTROCK said recently in the *Militar-Wochenblatt:*

"In wars of the future, the initial hostile attacks will be against the great nerve and communication centers of the enemy's territory, against its large cities, factory centers, munition areas. The war will frequently have the appearance of a destruction en masse of the entire civil population rather than a combat of armed men."

But the first blow will be struck in the air and followed immediately on the earth by a rather small, highly expert, well equipped army, traveling on caterpillar tractors and wheels, in armored tanks of speeds thrice those of the World War. They will strive to get around or through enemy's infantry and artillery and destroy his main nerve centers, headquarters, telephone centrals, radio stations, munition dumps, turning his army into a mob without coördination or supplies. It was revealed only recently that the British Army had adopted a similar plan, proposed by Col. R. J. F. Fuller, well-known military writer, for the campaign of 1919, had there been one.

The British, who first introduced the tank to an amazed German army in 1916—although Francis J. Lowe, an American, claims credit for himself and Edwin M. Wheelock of Winona, Minn., and Charles Tolles of Eau Claire, Wis., for the original suggestion—have now huge tanks resembling cruisers going twenty miles an hour, with four revolving turrets for machine guns and central turrets for three-pounders, which are supposed to be the finest land fighting machines in existence. Contrasting with these are baby one-man tanks controlled like motorcycles. America has a twenty-three-ton tank carrying a one-pounder and a machine gun. The French have a seventy-ton tank carrying a heavier cannon.

The British are so convinced that the tank is the land weapon of the future that Sir L. Worthington-Evans, Secretary of State for War, has announced that cavalry units will be reduced in size and pack horses will be replaced with mechanical vehicles for the transport of supplies.

American ordnance experts have been experimenting with an amphibious tractor to carry artillery and supplies.

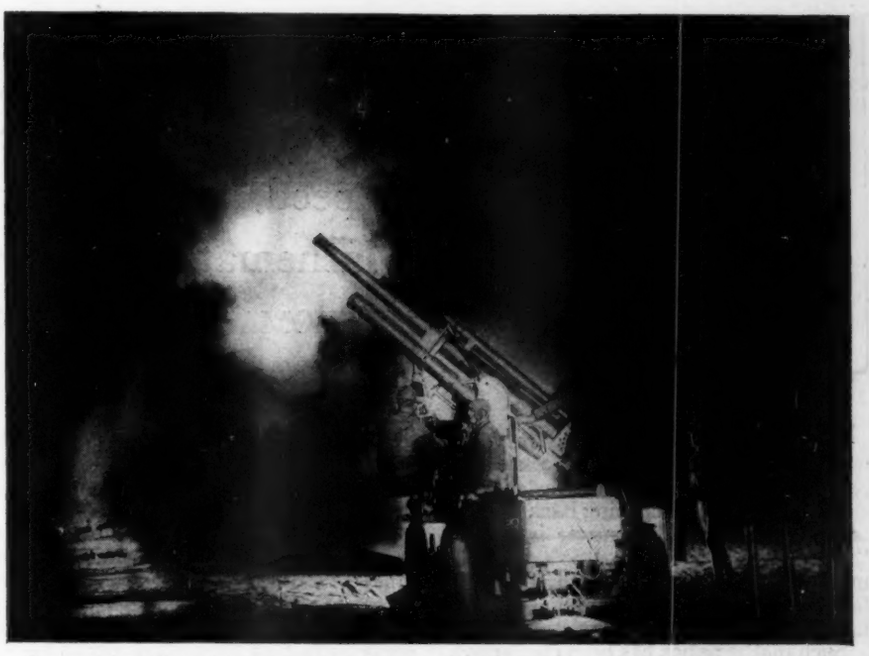
What new strange forms may not further attack take? Not so many scientists and soldiers laugh at the "death ray" as one might suppose. In 1924 a young Englishman named Grindell Matthews came to light as inventor of that. He had lost an eye from emanations of the projecting apparatus. Possibly Matthews has not discovered a workable death ray, but that doesn't mean that nobody has.

THE French Government is experimenting with an invention that may stop the engine of an airplane in mid-flight—surely a defense against air raids. The discovery of the cathode ray by Dr. W. D. Coolidge, of the General Electric Company, is an indication of the possibilities in America.

Toward the end of the war, the Sperry aerial torpedo was just becoming reality. In the next war it seems likely that aviatorless airplanes and unmanned ships will be directed on bombing raids. David Sarnoff, Vice President of the Radio Corporation of America, recently said:

"Heavy charges of high explosive may be placed under important Government buildings, docks, factories and other strategically important points, connected by radio receiving equipment capable of detonating the explosives when a certain secret code signal is sent on a particular wave length. Any power that prepared in this way could send out the signal on the outbreak of war, and paralyze his opponent."

And John Bakeless, author of "The Origin of the Next War," says a German staff officer has just declared that "warfare with bacteria holds great possibilities."



A powerful mobile antiaircraft gun in action at night at Fort Tilden, N. Y., against an imaginary attack by planes. Mounted on a fast and heavy motor truck, the gun is rushed to the point of attack. Searchlights point out the enemy and the gun fires every three seconds. Such guns have scored a hitting percentage of 9.15, and can send projectiles more than 12,000 feet into the air

A warlike scene at maneuvers at Camp Meade, Md., when the Army blimps *TC-5* and *TC-9* soared over tanks which they attempted to destroy with theoretical bombs without themselves being brought down by fire of antiaircraft guns. Land and air equipment have advanced far in efficiency since the World War

With infra-red rays, those just outside the red end of the spectrum as the ultra-violet are outside the violet end, there is much experimentation here and in France. Dr. W. W. Coblentz, of the U. S. Bureau of Standards, has worked out a signaling system invisible to anyone not having a detector.

The new noctovision searchlight, invented by John L. Baird, opens spectacular possibilities. With its invisible infra-red ray it may become possible to light up enemy trenches, fortresses and cities at night without their knowledge and then to attack them.

If scientific war does fail to gain quick decision, then will come the war en masse, the war of extermination. Men, women and children will carry out the command "Work or fight!" Our Army General Staff has been preparing ever since 1919 and 1920 when General Pershing as Chief of Staff set most of the ablest officers who had served with him in France and those who had shown conspicuous ability here, at the job of planning defense in the next war.

LIEUT. General Sir Gerald Ellison says in "The Perils of Amateur Strategy" that "the wars of the future will be national, and more than ever the civil populations will be brought within the zone of actual operations." Such a war will call more and more for centralization of authority, dictatorship, and so it will be run, vast as it is, by fewer and fewer men—great supermen in authority if not in stature. That is the belief of probably the best known writer on war in English today, Major General Sir Frederick Maurice, expressed in (*Continued on page 168*)

Walk East *and* You Lose Weight

And Your Speed, Seemingly the Same, Is Faster, Mathematicians Now Explain

By THOMAS M. JOHNSON

A FREIGHT train going from Chicago toward New York weighs less and travels faster than when it is going back to Chicago. The answer is neither "Now I'll tell one" nor "So's your old man." It is the mathematics of relativity, farthest reach of the human mind into the unknown—or, possibly, a mistake.

Such mathematics has been challenged, but is considered undeniably true by some philosophers who are eminent mathematicians. They say that if a perfectly accurate clock could be moved through space at the speed of light, it would not show that any time had elapsed; that time as we know it simply could not exist in the experience of the clock moving so rapidly. Time varies with speed. It is slower in Ecuador than in Iceland. You have to do whirligigs of reason to understand relativity.

But such stunts are exhilarating in company with Henshaw Ward in his new book, *Exploring the Universe*, published by Bobbs-Merrill. One of its many interesting chapters demonstrates that the Einstein theory may be no more mysterious than the motion of a second hand on a watch. Here is a story he tells to explain relativity:

A RUSSIAN professor of physics crossing the Black Sea westward mystified passengers and crew by weighing a chunk of lead repeatedly and carefully, then going back eastward aboard the same ship, still weighing, weighing, weighing. He was checking the statements of mathematicians that it would decrease in weight as it moved eastward.

If he had put that lead on a train from Chicago to New York going twenty-five miles an hour, it would actually have been going twenty-five plus 1000 or 1025 miles an hour, because the earth rotates eastward 1000 miles an hour. When the train went back, westward, it would have gone only 975 miles an hour.

The lead has more tendency to fly off the earth when it goes east, for the faster the earth's surface moves, the more likely is any object upon it to fly off, hence the object's weight is less.

And did you know that because the earth moves so fast in its orbit—twenty miles a second, one nine-thousandth the speed of light—its diameter contracts two and a half inches? And if it got going as fast as light there would be no earth, mathematicians say, because there is no velocity greater than that of light.

Relativity started because this motion of the earth aroused the curiosity of Professor A. A. Michelson, of Chicago. He wanted to know in what direction the Chicago Loop, say, actually moves, due to the earth's rotation on its axis, its revolution around the sun and its movement toward the constellation Lyra.

From a stone, floating in a vat of mercury, he raced rays of light reflected from mirrors, in paths at right angles, using delicate apparatus to register the smallest differences. Mathematics had indicated a difference of speed, but there was none. That meant a new theory of light, and startled the scientists.

Michelson made a more elaborate test to detect the earth's motion by light rays. He laid a quarter-mile square of twelve-inch pipe, placing mirrors and sending light rays in either direction to test speed difference. Again there was none.

Upon Michelson's observations is based the theory of relativity. If they are false, so is the theory. Some scientists have attacked both, but Ward declares the basic logic and resulting calculations of the theory of relativity are "the constitution and the cornerstone of physics."

"The word 'relativity' describes," he says, "not the new theory, but the fact that the old laws of physics were not universally true; they were true only in the limited sphere of inaccurate observation; they were merely *relative*. What the mathematicians have done is to derive formulas which shall be *universally true for all conditions of space and matter and motion*. A descriptive name for the new theory would be 'universality' or 'absoluteness.'"

Denying relativity is "just a theory," Ward says:

"Science has all along proclaimed that relativity rests on an *if*—*if* light does really behave as it seems to in the Michelson-Morley experiment. When it is shown that light does not so behave, science will profit by one of the most spectacular and useful demonstrations that the human intellect ever devised.

"Nothing will be lost to science except a temporary supposition, which will be gladly discarded. Science will then set an example by which all the philosophers and critics and theologians might profit; holding no faith that is not subject to revision when a new fact arrives."

Making You Acquainted with the Atom

FOREMOST among those tackling the "small end" of the queer behavior of matter is Prof. Niels Bohr, of Copenhagen, Denmark.

For his discoveries, that helped to upset the classical notions of electrodynamics, Prof. Bohr received the Nobel prize in 1922.

The cornerstone of all matter, the foundation on which all scientists must build their beliefs of the world's laws, is the atom whose picture Prof. Bohr paints for us. Like a miniature solar system, it has a nucleus surrounded by spinning electrons. Sudden "hops" of these electrons, Bohr has discovered, from an outer to an inner orbit, release the energy that gives birth to light.

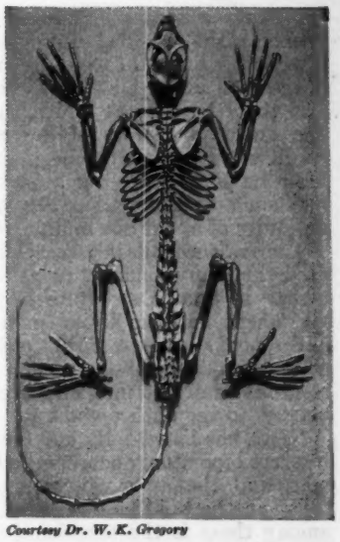
As an illustration of the way in which these discoveries help straighten out the puzzles of our imperfect knowledge, an offshoot of the laws of relativity—the "quantum theory" proposed by Planck and later twisted about to fit Einstein's theory of relativity—has at last been harmonized by Prof. Bohr with actual spectra seen through a spectroscope. This "quantum theory" deals with the way in which an electric light, a gas stove or an atom emits "chunks" of heat or light; with certain changes, Bohr has shown how its application clears up such mysteries as the splitting of light from hydrogen gas by an electromagnet.

A skeleton of a modern man, above, and a 50,000,000-year-old fossilized skeleton of a monkey, the *Notharctus osborni*, at the right of this page, show how man has developed. Note longer limbs, shorter body and larger skull for the expanded brain

Sir Arthur Keith Says:

Darwin Was Right

Chief of British Scientists Declares Mass of Data Shows Man Rose from Among Apes



Courtesy Dr. W. K. Gregory

By EDGAR C. WHEELER

EVOLUTION is in the news again. In the city of Leeds, England, a few weeks ago the British Association for the Advancement of Science witnessed one of the great moments in a world-famous trial, bitterly contested for more than half a century—the trial of Charles Darwin and the theory of evolution he first propounded.

In silent attention they heard the foreman of the jury state the issue and pronounce the verdict of modern research:

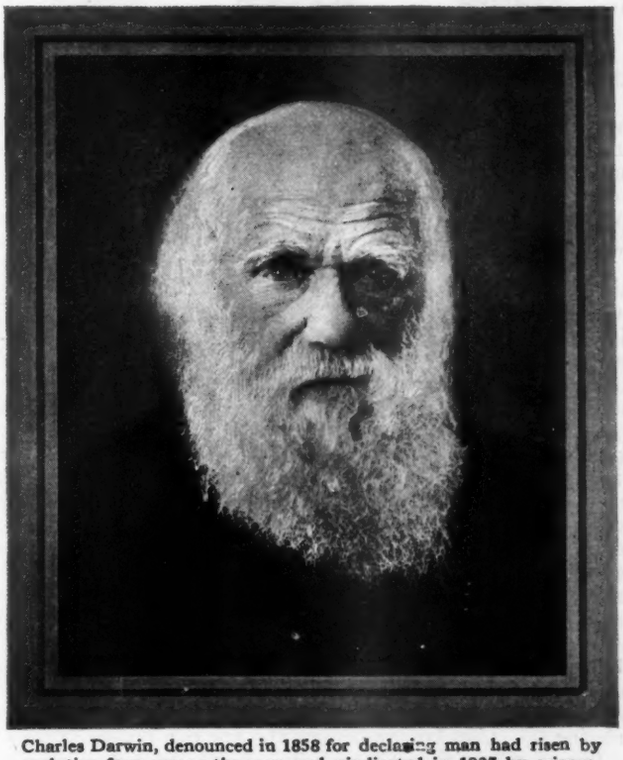
"Was Darwin right when he said that man, under the action of biological forces which can be observed and measured, has been raised from a place among the anthropoid apes to that which he now occupies?

"The answer is: Yes! And in returning the verdict I speak but as foreman of the jury—a jury which has been empaneled from men who have devoted a lifetime to weighing the evidence."

THE man who made the pronouncement was Sir Arthur Keith, president of the Association, recognized as one of the most eminent students of man and his origin. His words echoed around the earth. They were momentous, not only because they summarized the opinion of modern science on an issue that has been debated for the span of a lifetime, but because of the very circumstances in which they were spoken.

For Sir Arthur's emphatic "Yes" was uttered from the same platform in Leeds where, sixty-nine years before, one of his most distinguished predecessors, Sir Richard Owen, foremost anatomist of his time, had poured scorn on the idea that man and ape could have common ancestors!

Then, in 1858, as Sir Arthur recalled, the audience "was convinced almost without a dissentient that man had appeared on earth by a special act of creation. Whereas," he added, "the audience which I now have the honor of addressing, and that larger congregation which the wonders of wireless bring within the reach of my voice, if not convinced Darwinists, are yet prepared to believe, when full proofs are forthcoming, that man began his career as a humble primate animal."



Charles Darwin, denounced in 1858 for declaring man had risen by evolution from among the apes, and vindicated in 1927 by science, which has added apparently irrefutable evidence to his own proofs

In sixty-nine years Darwin's amazing conception of creation has remained to be vindicated by the same exacting body of scientists which once ridiculed. And to the world at large has come an understanding of the majestic idea of man not as a creature cast in a mold like a toy in a metal shop, but as one reaching beyond his animal cousins to heights of intelligence and enlightened power through Nature's miracle of endless change.

And yet, strange to say, the evidence which has so altered the whole course of history is entirely circumstantial. Science never has, and possibly never will, discover direct proof linking man and the ape in common ancestry. Instead, it has assembled hundreds of circumstantial proofs—in the soil of ages past, and in the teeming life of the present—which seem to point unmistakably to the one conclusion.

Darwin, master detective of science, began the collection of this mass of evidence. With a genius for keen observation, he scrutinized the countless forms of life about him—the animals, plants, birds, trees, insects and strange creatures of the sea. He traced their life history and compared one with another.

IN ALL he found the same laws of evolution at work. On the very day that Sir Richard Owen denounced the idea that man was "merely a transmuted ape," Darwin worked on the first chapter of a book embodying his observations. In "The Origin of Species," he described his theory that Nature evolves new forms of life from old by the processes of natural selection—by choosing for survival those individuals and races best equipped to cope with their surroundings. This he followed with other works, including "The Descent of Man," in which he traced mankind back to beginnings among the humble animals. It was a history based on circumstantial proof drawn from living documents; on painstaking analysis of the body, behavior, and life record of man, as compared with those of animals resembling him.

"Fifty-six years have come and gone since that history was written," said Sir Arthur. "An enormous body of new evidence has poured in upon us. We are now able to fill in many pages which Darwin had perforce to leave blank, and we have found it necessary to alter details in his narrative; but the fundamentals of Darwin's outline of man's history remain unshaken. Nay, so strong has his position become that I am convinced that it never can be shaken.

"All the evidence now at our disposal supports the conclusion that man has arisen from an anthropoid ape not higher in the zoölogical scale than a chimpanzee, and that the date at which the human and anthropoid lines of descent began to diverge lies near the beginning of the Miocene period. On our modest scale of reckoning, that gives man the respectable antiquity of about one million years."

The evidence falls into two chief groups: first, the many amazing points of resemblance in bodily structure and life development between living man and the anthropoid apes—the gorilla, chimpanzee, orang-utan and gibbon; second, the fossil records of ancient men and their resemblances to the anthropoids.

Keith has listed fully 100 distinct features of anatomy common to both man and the apes which are not found in the tailed monkeys. Chief among these is the surprising similarity in brain structure.

"So alike are the brains of man and anthropoid," Sir Arthur declared, "that surgeons and physiologists transfer experimental observations from one to the other. Thousands of anatomists and physiologists have studied and compared the brain of man and ape; only a few months ago Professor G. Elliot Smith summarized the result of this extensive inquiry as follows:

"'NO STRUCTURE found in the brain of an ape is lacking in the human brain, and, on the other hand, the human brain reveals no formation of any sort that is not present in the brain of the gorilla or chimpanzee. The only distinctive feature of the human is a quantitative one.'"

It is just this difference in brain quantity, in the expansion of all those parts found in the ape brain, Keith tells us, that has given man his wonderful powers of feeling, understanding, acting, speaking and learning.

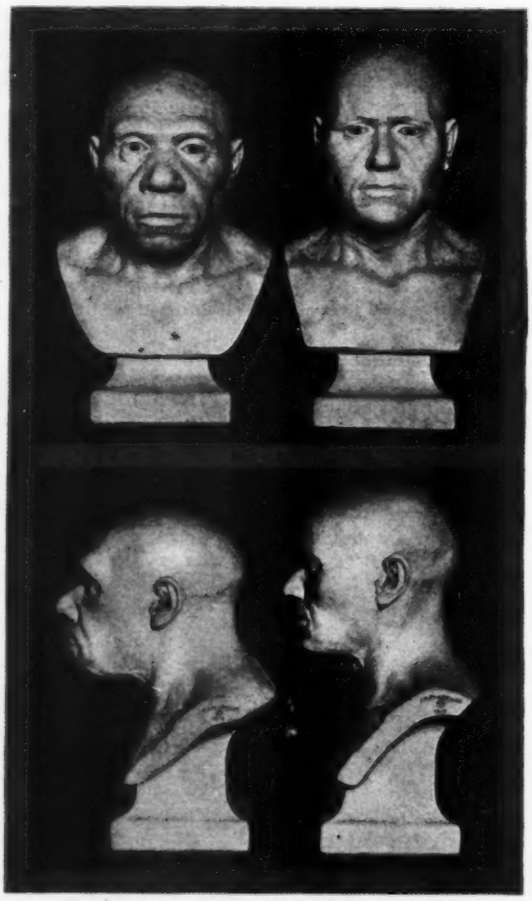
Darwin, after years of painstaking and exact observation, succeeded in convincing himself that, immeasurable as are the differences between the mentality of man and ape, they are of degree, not of kind. Prolonged researches made by modern psychologists have but verified and extended Darwin's conclusions. No matter what line of evidence we select to follow—evidence gathered by anatomists, by embryologists, by physiologists or by psychologists—we reach the conclusion that man's brain has been evolved from that of the anthropoid ape and that in the process no new structure has been introduced and no new or strange faculty interpolated.

Other striking points of similarity are these:

The blood of man and that of the great anthropoid apes, tested by exact methods of determining their affinity by chemical reactions, have been found to give almost the same reaction.

The anthropoids are susceptible to the same diseases, and their body tissues react the same way as man's to poisons, stimulants and sedatives.

Bone for bone, muscle for muscle, organ for organ, the structure of man is closely comparable to that of the apes. The chest and forearms show distinct marks of transition from a four-footed climbing animal to a four-footed creature that uses its forefeet as hands for grasping food. The feet are remarkably alike. Even vestiges of the muscles which give the ape its ability to grasp with its thumb-like big toe are possessed by human beings. Indeed, many persons are actually able to grasp objects in this way. Again, a small muscle known as the peroneous tertius, long believed to be peculiar to the human foot, has been discovered in recent years in the feet of at least two gorillas. One of these discoveries was made by Dr. Dudley J. Morton, of Yale, while dissecting a foot of the famous trained gorilla, John Daniel I.



Copyright by Dr. J. H. McGregor

Busts of the Neanderthal man of 40,000 years ago, left, and the Cro-Magnon, 15,000 years ago, right, reconstructed from their skulls. The evidences of higher intelligence and feeling are seen at a cursory glance

Like human beings, the ape can boast a vermiform appendix. Keith tells us that chimpanzees in captivity actually have been known to develop appendicitis, a distinctly human ailment.

In the processes of reproduction and the development of offspring, the similarities are equally striking. Even the simple germ cells from which new life springs are closely alike in man and anthropoid. The same elaborate processes that mark the beginning of complex embryo life occur in both, and are found in no other animals.

Comparison of the teeth of men and the anthropoids, both modern and ancient, have revealed still further evidence of common origin. Dr. William K. Gregory, of the American Museum of Natural History, a leading authority, recently declared:

"In the light of these and similar researches and in the total lack of real evidence to the contrary, we may regard Darwin's conclusion that man is of an offshoot from the anthropoid stem as one of the most abundantly documented inferences in the whole field of biological science."

But most fascinating of all the corroborative evidences for Darwin are the discoveries, since his death, of the fossil traces of prehistoric men and their stone implements.

"If Darwin was right," said Sir Arthur Keith, "then as we trace man backward in the scale of time, he should become more bestial in form—nearer to the ape. That is what we have found. The evidence of man's evolution from an apelike being, obtained from a study of fossil remains, is definite and irrefutable."

Oldest and most primitive of the early forms of humanity thus far discovered is the famous Java Man, called Pithecanthropus Erectus or Ape Man, believed to have lived at least half a million years ago. The unearthing of his fossil remains—the top of a skull, a thigh bone and two teeth—in a river bed in Java in 1891, is regarded by Keith and other evolutionists as having thrown the greatest light on man's ancient ancestry. They reveal a creature possessing a strange combination of manlike and apelike features. "The thigh bone," says Keith, "might easily be that of a modern man, the skull cap that of an ape, but the brain within that cap, as we now know, had passed well beyond the anthropoid status."

THESE remarkable fossils were studied not long ago by Dr. J. H. McGregor of Columbia University, member of the staff of the American Museum of Natural History and an authority on prehistoric restorations. He found that while the inside of the skull cap indicated a brain smaller and more apelike than any human brain, the development of the regions governing articulate speech indicated a man possibly just learning to talk. In outward appearance, the Java Man must have been distinctly apelike, yet the straightness of the thigh bone showed him to be a man who had learned to walk erect.

Next in point of antiquity are the remains of the Piltdown, or Dawn Man, who lived somewhat later than the Java Man, probably less than half a million years ago. They indicate that men of that far-off period, while still displaying outward features of the ape, had acquired a definitely human brain. Next come the Heidelberg Man, somewhere about 250,000 years ago; Neanderthal Cave Man, 40,000 years ago; Rhodesian Man, 20,000 years ago, and finally the Cro-Magnon Man, 15,000 years ago.

In the Cro-Magnon anthropologists see evolution culminating at last in modern man. If you compare Dr. McGregor's remarkable reconstructions of the Neanderthal and Cro-Magnon men, reproduced with this (*Continued on page 140*)

Clothes Woven from Rock

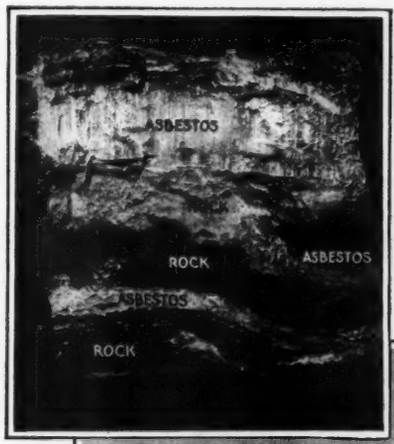
Asbestos, the Strange Mineral Textile, Alone Enables Man to Make Flame His Obedient Slave

By ORVILLE H. KNEEN

THE Shell oil officials breathed easier. With 2,460 feet of ten-inch pipe securely cemented at the bottom, they felt their newest well was safe against blowing out, the bane of the oil driller's life. No oil well in history, once cemented, had ever blown out. As they were congratulating themselves the cement plug shot skyward and a geyser of oil and gas roared six hundred feet into the air to be transformed in a flash into a pillar of flame, topped with dense black clouds of smoke and raining fiery disaster. A flaming torch with millions of cubic feet of gas and oil going to waste.

They wired for Alexander—Alexander the dynamiter. He came and looked and called a "fireproofing" specialist, and together they essayed the most daring exploit in the annals of fire-fighting, a masterpiece of sheer courage in a profession where courage is commonplace.

Clad in fireproof garments—hoods, jackets, overalls, boots, gloves—and shoving fireproof shields before them, they built at the base of the towering flame a wooden platform covered with fireproof board and set thereon a hundred pounds of dynamite, paying out fireproof wires attached to it as they retreated.



A chunk blasted from an asbestos mine, showing the alternating layers of rock and of the fibrous fireproof material, also rock of its own queer kind

ALEXANDER looked back. The platform was tipping. If it fell the explosion would fail of its purpose—to blow the flame away from the well. If Alexander and his aids went back and were there when it exploded—

So in seconds that seemed a breathless age to the onlookers these men went back and righted the platform and retired. Then by the fireproof wires the dynamite—enough to wreck a town—was detonated. Derrick, machinery, buildings were wrecked; a new well must be drilled; but the fire was out and the oil was saved, thanks to the strangest material in Nature, asbestos—the only mineral, the only rock that can be woven into fireproof garments and molded into instruments impervious to flame.

All photographs by Johns-Manville, Inc.

In suits, hoods, helmets and boots of asbestos cloth these men defy the killing heat of a burning Wyoming oil well to prepare at the base of the gushing flame a dynamite charge that will extinguish it. Without this armor, woven from fibrous rock, there would be no approaching the blaze

The mineral cotton. Crude asbestos looks like rock. It is rock, but pulled apart it is found to be of myriad fibers fine as finest silk or cotton

With asbestos armor and tools men can fight the fiercest fires known since first the disgruntled Prometheus stole the pyric secret from the gods or since primeval man discovered it. That is why when oil wells have flamed asbestos clothes and shoes have been rushed by Johns-Manville, Inc., from Chicago and New Jersey by air mail as far as the Wyoming fields. That is why even the messenger dogs of forest rangers in California are clad in asbestos coats to defy the timber flames.

Some have thought the three who survived Nebuchadnezzar's fiery furnace were clad in asbestos. Ancient writers tell of a "stone which is carded and woven to form handkerchiefs" for emperors, the fabrics "cleansed by casting them into the fire." Corpses of royal Romans were sometimes wrapped in asbestos that their ashes might be preserved after cremation.

An ancient Greek writer tells of a lamp of gold for the statue of Athena with a wick of unburnable "karpasian flax." The Greek word asbestos means unextinguishable. Eskimos, finding asbestos in Labrador, have long used it for lamp wicks.

Marco Polo's countrymen only laughed when he brought tales, in 1295 A.D., of Tartars who had clothes made from the skin or hair of a mythical salamander, which lived only in fire. Polo learned that the material was really "earth-flax," mined in the Ural Mountains as it is today, dried, powdered and woven. Magicians, he said, cleansed it in fire. Four centuries before, the Emperor Charlemagne performed the same "miracle" for his guests with his tablecloth.

THE mystical material, "fibrous and crystalline, elastic and brittle, heavy as rock in its crude state, yet as light as thistledown when treated mechanically," has withstood the heat and enormous pressure of volcanic fires and earth adjustment, apparently without alteration. Changes in temperature cannot make it expand or contract. Since the earth was in its infancy, these veins of silky fibers have seemingly survived when the hardest rock has worn or melted away.

Such everlasting qualities lend color to a story from the Canadian woods, not far from where most of the world's commercial asbestos is mined. An Englishman who had worked in an asbestos factory in England came to work in the woods. One evening the French Canadians saw him cast his socks into the hot stove and a few moments later draw them out and put them on again. They promptly decided him to be either the devil himself, or a devilish assistant, and refused to stay on the job unless he should be instantly dismissed.

"You are," a well-known asbestos man told me, "almost surrounded with asbestos. Modern comfort and convenience would be inconceivable without this mineral curiosity.

(*Continued on page 174*)

Welder—New Tailor *of* Steel

Also a Carpenter, Cutting and Fitting the Metal and Fusing It Silently into Machines and Even Buildings of One Solid Piece

By L. G. POPE

Easier riding for railroad and street car passengers is sought by the U. S. Bureau of Standards and the American Electric Railway Association in experiments in welding rail joints to eliminate jar as the wheels move from rail to rail

"THE clatter of steel construction is growing unbearable. It is making hotel and apartment rooms all but unlivable. It is disturbing our work and shattering our nerves. It is becoming a real menace to public health. What can we do about it?"

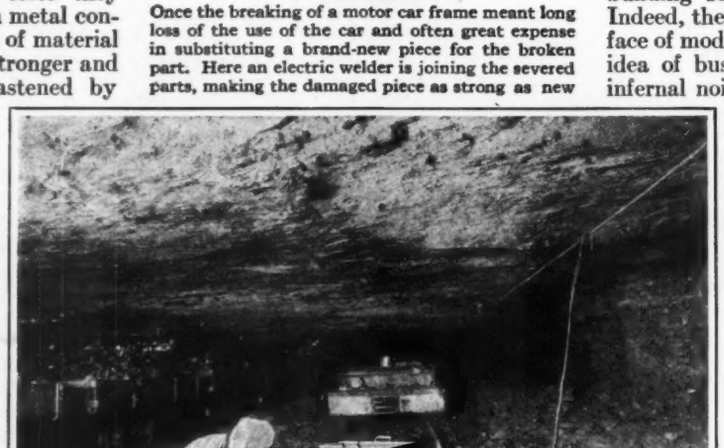
Such, in effect, was the statement of Dr. Louis I. Harris, Commissioner of Health in New York City, a few weeks ago, when he called a group of engineers into his office in an effort to find a solution.

He did not have to inquire far. The engineers, almost to a man, assured the commissioner that an easy remedy was at hand in the substitution of the welding torch for the riveting gun in joining steel beams and girders. "The deafening clang of riveting can be silenced for all time," they told him, "whenever builders can be induced to discard present methods of construction and employ the remarkable processes of welding recently developed in engineering laboratories."

Soon, they prophesied, the ribs of great skyscrapers and other structures of metal, will be knit together not by pounding hammers, but by silent needles of flame. By the proof of scientific tests they revealed that welded joints in metal construction not only save costs of material and labor, but can be made stronger and more durable than those fastened by rivets.

Once the breaking of a motor car frame meant long loss of the use of the car and often great expense in substituting a brand-new piece for the broken part. Here an electric welder is joining the severed parts, making the damaged piece as strong as new

THIS recent effort to silence the din of a big city is only one evidence of the revolutionary changes being wrought throughout the metal industries by the new science of metal carpentry. The boiler factory, once the synonym for earsplitting racket, now becomes a peaceful place where automatic welders, working quietly as seamstresses, bind metal edges together with electric arc or oxy-acetylene flame. In machine manufacturing plants the iron foundry with its furnaces, patterns and molds for casting parts from molten metal, is giving place to the welding shop. There huge machine frames, once bulky castings, now are fabricated from metal "lumber," cut to size and welded together, much as a cabinetmaker would build a fine piece of furniture from wood.

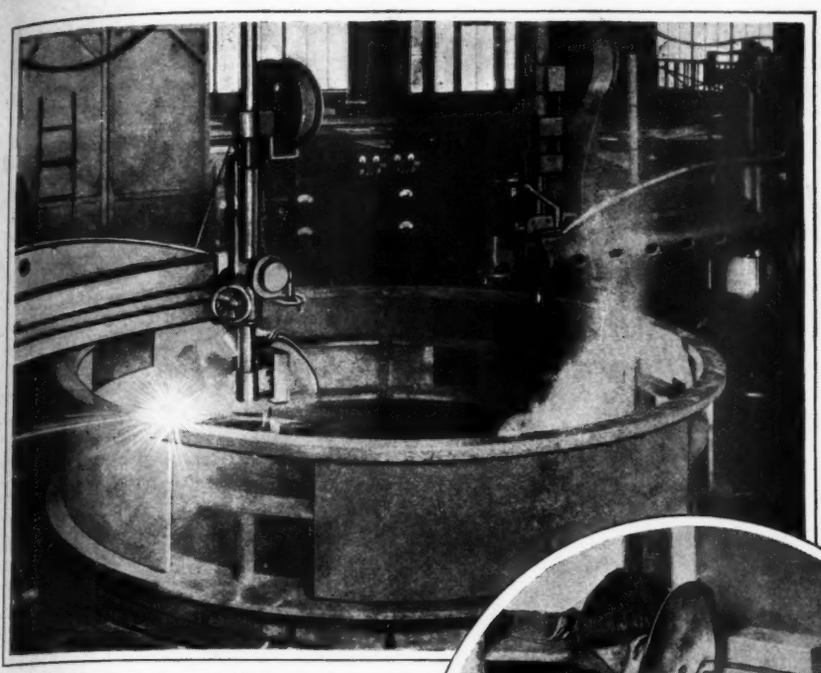


How electric welding aids even in coal mining. Here a workman is seen with his torch, heated from an electric wire, and his weld metal joining the rail bonds in a mine at Keith, W. Va. The rails help carry the current that moves cars on the electric railway and are joined by metal bonds to make the electric circuit complete. The bonds are effectively made and repaired by the new torch method

Bridges, ships, railways, pipe lines, automobiles, car wheels—even such smaller useful articles as ladders, tables, chairs, workbenches, wheelbarrows—are being fashioned in remarkable new ways by the welder's fiery needle. Airplanes, too. For example, the plane which carried Lindbergh to Paris embodied the welder's handiwork; for the framework of the fuselage was made of seamless tubing of chromemolybdenum steel with welded joints.

New uses are being discovered daily. The possible applications of this new building science seem almost limitless. Indeed, they bid fair to change the whole face of modern industry. The old popular idea of bustling industry as a thing of infernal noise, belching smokestacks and dirt, gives place to the idea of silent cleanliness. Today manufacturers desire neither smoke nor racket. They recognize both as signs of inefficiency. And they realize that the overwrought nerves of city dwellers are demanding the silencing of industrial noises, just as they now refuse to tolerate the nuisance of cinders and gases.

IN DEVELOPING methods of silent construction, a number of large electric companies have taken the lead. As told in previous issues of POPULAR SCIENCE MONTHLY, the Westinghouse Electric and Manufacturing Company already has erected four rivetless buildings and it is now constructing a fifth arc-welded building, at Derry, Pa. Similarly, the General Elec-



A two-head automatic arc-welding machine in General Electric works joins metal pieces into 14-foot generator frame and saves casting cost

At the right: A close-up photograph of the inside welding of the stator above, showing how the molten metal fuses the parts into one piece

tric Company at Schenectady, N. Y. has announced that its future building programs will call for the substitution of arc-welding for riveting throughout.

In other parts of the country welded buildings recently have appeared. For example, a few weeks ago steel for a new ballroom on the roof of the Alcazar Hotel in Cleveland, O., was erected without driving a single rivet, by using an arc-welding process developed by the Lincoln Electric Company of Cleveland. The work revealed two important advantages: first, welding made it possible to attach the addition to the old building with very little disturbance to existing walls; secondly, guests were undisturbed by noise.

Eliminating of noise, however, is only one of many advantages of welding. Practical tests in the laboratories of the U. S. Bureau of Standards and of the Carnegie Institute of Technology have demonstrated that welded joints scientifically made are stronger than riveted ones; indeed, are sometimes stronger than the metal they fasten together. Moreover, welding effects economies in material. Not only does it eliminate steel plates and angles ordinarily required in riveting, but by doing away with the drilling of rivet holes it permits the use of lighter structural materials.

THE same economies appear as well in the application of welding to the manufacture of machinery. In the shops of the General Electric Company at Schenectady, electric arc-welding recently has revolutionized the making of many electrical machines.

Until a short time ago, for example, the huge frames of generators, which supply electricity for millions of homes and industries throughout the country, were cast in the iron foundry. These machines consist of two main parts—the stator, or stationary part, and the rotor, which rotates within it. For large hydro-electric generators the stator frames often measure forty to sixty feet in diameter. The enormous amount of metal and foundry workmanship has involved a long and expensive series of processes—making wooden patterns, forming molds, pouring molten metal into the molds, cooling, cleaning, heat-treating and machining the castings.

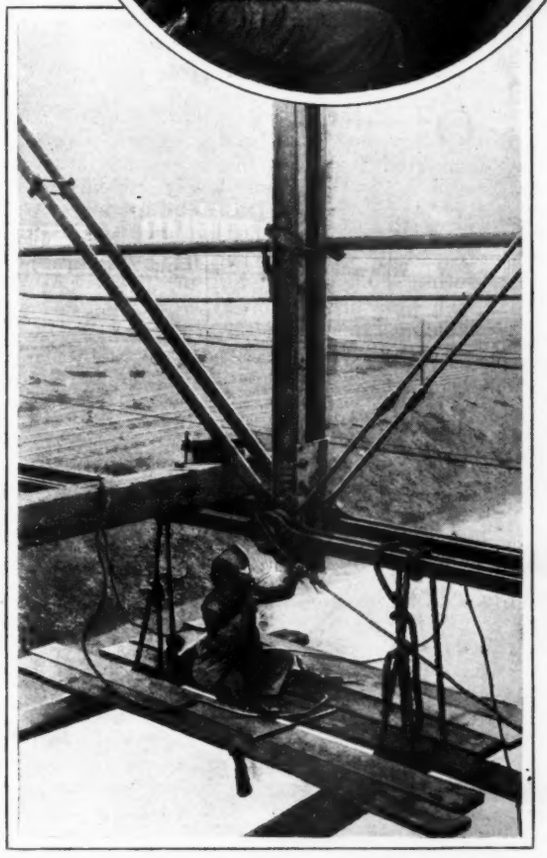
Now, the great frames are built up from a number of pieces, much as a carpenter works with wood. These metal pieces are rolled out and cut to shapes and sizes, then joined by welding—a matter of bringing the parts close together and filling the crack between them with molten steel, which unites with the metal and forms an unbroken joint. The heat for melting the welding metal and fusing the joint is supplied by an electric arc.

IMPORTANT economies in material and labor are claimed for the new method. Machine frames can be made lighter in weight, yet as strong as heavy castings. In making large electrical machines, especially, welding proves a time saver. Virtually all these large machines are "tailor-made"; that is, built to a special design to meet special requirements. When castings were used, this necessitated preparation of special drawings, patterns and often special pits in the foundry. Now standard metal slabs, sheets and bars can be cut and shaped, and speedily arc-welded together.

Still another advantage is the freedom from flaws and breaks in the completed machine. Previously a casting made at great expense frequently was found to contain some defect which made it worthless. Again, when a casting was accidentally dropped it sometimes developed a crack or part of it was broken off. The break seldom could be repaired. With welded machines, however, experts say there is little possibility of breakage in rough handling. Even if damage is done, it can be readily repaired.

In the Schenectady plant, welding is done largely by automatic machines which impart the desired motion to the rod of weld metal, or electrode. The rod is fed automatically from a reel to the arc which forms the weld at a rate of six inches a minute. On short seams and around fittings hand welding is used.

In machine repair work of all kinds welding is proving indispensable. Worn shafts on motors and other rotating machinery are built up by depositing metal on them by the welding processes, then machined down (*Continued on page 152*)



Repairing a bridge by the electric welding process, thereby saving time and expense of labor, new material, transportation and installation. The iron vertical posts have been found corroded. Weld metal and the oxy-acetylene torch are brought forward. The rotting parts are ground out and then replaced with metal fused in to become an integral part of the post

"*I'm* Going to Send *My* Boy to College"

A Plumber Tells from Experience Why He Believes a Diploma Is a Springboard to Bigger Opportunity

By J. B. MINNERLY

NOT so long ago a big-salaried job came sailing into my hands—and I muffed it. Not because I wasn't capable of handling it, but only because I didn't have a college diploma to catch it with.

I'd been doing considerable work for a wealthy man who is interested in several construction and manufacturing companies. I'd installed a large heating system for him, among other jobs. He was impressed by the fact that I knew more about steam installations than his architect did. He saw I was able to write my own specifications and correct technical errors made in the blueprints by a draftsman who should have known better.

Later I gave this business man some expert advice on oil burners and automatic stokers—advice that saved him money and lowered his fire risks. He discovered that I was familiar with electrical control circuits and was thoroughly up on combustion and radiation problems—in fact, could handle about everything in the heating line.

He took me for a technical school graduate and one day he began to tell me about a fine opening for a heating engineer.

"By the way," he interrupted himself, "what was your school?"

"Grammar school and the plumber's trade," I answered.

"We-ell," he said, "I'm afraid this place I had in mind would require a graduate engineer. It needs a man with a thorough scientific background."

Even before he spoke these words, I had realized the thing was all off. The lack of a college degree had cost me other fine opportunities before this. And the worst of it is, my friend was right. I could have handled his job, but a trained engineer could handle it better.

ON MANY practical jobs I can hold my own with college men. I've corrected flaws in domestic heating layouts for which some highly educated expert was responsible. I'm perfectly at home in pounds of steam and tons of coal—but when an engineer begins to spring "B.T.U." on me, or to discuss high pressure steam systems for big buildings, then I'm lost.

I only know what practice in a fairly limited field has taught me. From a plumber I've climbed to a contracting business of my own. I've branched out to steamfitting and sheet metal work. I flatter myself I've done pretty well. But if I'd had a college degree I'd have done a great deal better.

Lots of ambitious mechanics will tell you the same thing from their own experiences. Lack of a college education hampers a man, these days, at every turn.

And that's why I'm planning to send my boy to college.

A college diploma is a springboard to bigger opportunities—just the diploma itself. And if a fellow has not only the diploma but one half the knowledge of science and the thinking ability he's supposed to have before he gets his diploma, why then he can turn his opportunities into success far greater than the average mechanic can hope for.

From skilled craftsmen I've often heard the remark, "If only I'd had an education, think where I'd be now!"

But did you ever hear a university graduate say, "If only I *hadn't* had an education, think where I'd be now!"

No. College men don't talk that way, because the plain facts are the other way round.

Oh, of course you'll often hear people say some of the things that Mr. Payne did in his "I'm Going to Raise My Boy to Be a Plumber" article, in last month's issue of POPULAR SCIENCE MONTHLY. But they don't really mean what they say. For instance, Mr. Payne suggests that he'd like his boy to learn a trade—unless the boy shows ability for some profession. There's the joker. Everybody knows that business generally is a profession, today, and that big business is where the really good incomes are to be had.

AND for my part, I think that with the prosperity that's ahead of us in this country, and with the growing complexity of big business and the constantly increasing demands for quick-thinking, clear-reasoning executives, there's bound to be larger and larger demand for the college man. And so I think it's a mistake to advise boys not to go to college, just because they'll only get $20 a week when they graduate, to compare with the steamfitter's possible $66 a week.

As I see it, all discussions like this one are set to boiling by superficial thinking about that one point of the so-called high wages earned by skilled mechanics in certain trades.

All right. Let's look at those wages. And let's look at what a man does to get them. Outside of printing and allied industries, most of them are paid in the building trades with which I'm familiar. Talk about a "healthful

"When I go fishing, I use the sort of bait the fish are taking. And it's plain that the best fishing for jobs, today, can be done from a commencement platform with a college diploma for the bait"

outdoor life!" Just try it once. The work is often deadening to the mind, stupefying, physically exhausting—sometimes dangerous.

For instance, take steamfitting and structural ironwork, on which I've seen some fairly recent figures. In 1925, out of eighteen major classes of industry surveyed in eleven states, there was greater accident frequency in steamfitting and supplies and in structural ironwork than there was in any but two other industries.

Anybody who has worked on or watched a construction job knows the risks a man runs, and how they compare with the easy life of a white-collar job. There's many a widow and her small family skimping along on a mother's pension from the state, because her husband was a "highly-paid" plasterer working on a scaffold, or a structural ironworker or a carpenter, instead of an "underpaid" college graduate working at a desk.

DON'T forget, then, that many of the trades are not only a harder and rougher life but a riskier one than what the average college graduate goes into.

And it's all right to theorize about a skilled mechanic being able to earn a good living and meanwhile educate himself for something better. But that isn't so easy as it sounds. A fellow who works all day "on the wall," or struggles with heavy materials and worms his way into cramped corners to wrestle with pipes and wrenches, is just too dog-tired at night to study.

Why, a friend of mine, a mason contractor, felt the way I do about college. So his boy Tim went to Cornell—for one year. Then Tim said he'd learned how to study, and he decided to quit college, grow up in his father's footsteps, and continue to educate himself while he earned $8 a day as a helper.

A short time ago Tim's father asked the boy why he wasn't spending more time with his books.

"Dad," said Tim, "after I've worked all day and get home to supper, I'm ready to hit the hay. My body's so tired that my mind won't work."

Besides, there's nothing in the life of an apprentice that will stimulate him to keep on with self-education. The influences are all the other way. The other fellows sneer at intellectual interests. The boy is discouraged from books and study and thinking. He's got to fall into rough habits and rough language or else be an outsider. Everything tends to narrow his point of view.

But a college boy at the same age is stimulated on every hand to broaden his mind and pick up not only knowledge, but the polish that will make him successful in meeting big men.

No—there's nothing in that argument about being able to live high on a mechanic's income and meanwhile educate yourself. I'm self-educated, and I don't think I've done a bad job. But nobody who hasn't gone through it knows what wasted effort and mistakes and blind, heartbreaking toil go into a self-guided education. I've picked mine up without help, at odd moments, with out-of-date text books from the library. I've studied until late at night when I had a hard day's job behind and another ahead. I don't begrudge the toil—but so much of it was inefficient and fruitless! Educating yourself is like trying to fly across the Atlantic without a compass.

And now for those "high wages" which are supposed to compensate the skilled craftsman for the hardships, risks or limitations of his life.

"Why," says Mr. Business Man playing golf with his friend, "do you know what plumbers are getting in my town? Twelve dollars a day! Plasterers are getting fourteen dollars! Think of it! For doing something I could learn to do in six weeks!"

I'm not so sure Mr. Business Man could learn as fast as he thinks. And I'm sure he wouldn't stick to it very long after he had learned. It's not the same pleasant exercise that Saturday golf is.

But even if he did stick to plastering, say, for a whole year—what would his income be?

I suppose he figures fifty-two weeks in a year at $14 a day. That would be about $3,900 a year, as he dopes it out. Well, $3,900 a year isn't so bad, although the figures used in Mr. Payne's article show that a technically trained college graduate on the average reaches $4,000 when he's thirty-two years old, and keeps on going up to $7,500 when he's fifty-two. But the average plasterer's wage—even at Mr. Business Man's guess—doesn't reach $4,000 at the age of thirty-two; and by the time the plasterer is fifty-two his pay is more likely to be diminishing instead of increasing.

However, there's a still bigger flaw in the argument.

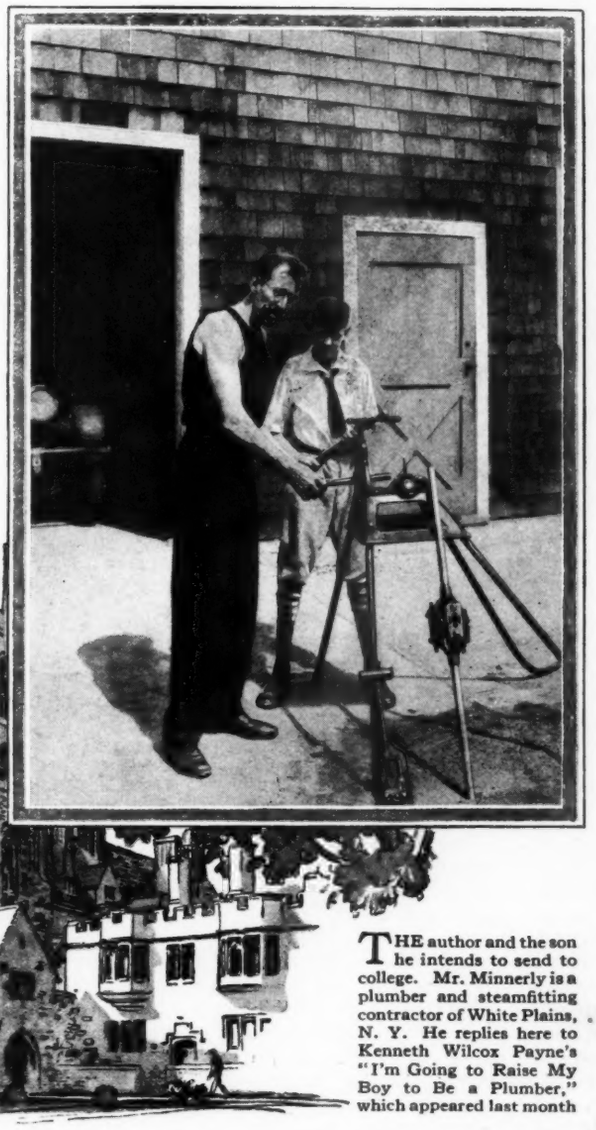
If we're going to compare national averages, and college graduates with skilled workers, it isn't fair to take the exceptional wages of a few trades in large cities.

Take the skilled trades generally for the whole country, and we find from Government figures that the average rate of wages in 1925 for fourteen of the better paid crafts was $10.24 a day.

WHICH means that the skilled laborer's income—assuming he works five and a half days a week throughout the year—is only $2,340 instead of $3,900. But he doesn't work the full fifty-two weeks. He doesn't get a vacation on pay the way the white-collar worker does. Legal holidays are lost time. If he's sick, or if the weather is bad, his job stops. So, to square up our comparison with the white-collar man's salary, let's deduct the two weeks vacation and the holidays, and we find our "highly paid" mechanic is getting only about $2,100 a year to compare with the college graduate's $4,000. Why, the other day I saw a table showing that the *starting* salary of 245 Harvard graduates in 1926 averaged $2,000—which is almost as much as the average mechanic can hope for year after year throughout his working life.

And that doesn't take sickness into account, or lost time due to trade conditions. It's said that on the average, in normal periods, lost time in the building trades will amount to about one third of a year. I've looked up the most reliable figures I can find, and they show that lost time in the building trades for 1925 was equivalent to a year's idleness for 12.3 percent of all workers engaged.

All of which seems to me to puncture



THE author and the son he intends to send to college. Mr. Minnerly is a plumber and steamfitting contractor of White Plains, N. Y. He replies here to Kenneth Wilcox Payne's "I'm Going to Raise My Boy to Be a Plumber," which appeared last month

Mr. Business Man's theory that a plumber or carpenter earns about $66 a week for fifty-two weeks.

Besides, the mechanics in the building trades aren't the only skilled workers. If we're going to take college graduates as a class and compare them with skilled labor as a class, we've got to go beyond the construction industry. A recent report of the National Industrial Conference Board covering twenty-six great American industries shows that the average hourly earnings for skilled male workers are 65 cents—which comes to $5.20 for an eight-hour day instead of the $10 or $12 a day earned by certain groups.

NOW if Mr. Payne is going to limit his argument to the most favored groups, and declare that a boy ought to be raised for a plumber so he can earn $12 a day, then I can say with equal fairness that I'm going to send my boy to college so he can be a consulting engineer at $30,000 a year—which is a figure some engineers reach and which no plumber ever reached as a plumber.

And that brings me to the big point on the financial side of this discussion: the much larger financial opportunities available to the college man.

I want to make clear, first, however, that I'm not spreading any hard luck story on behalf of the manual worker. Skilled labor is getting reasonably good money in this country. Many workers can live well, drive a car and have leisure and pleasures. I think most men get about what they're worth, and haven't got any kick coming.

Indeed, that's the nut of the whole thing. The mechanic's wage fairly measures what he's worth; and he's never worth any more because he hasn't got the college education that helps a man make himself worth more and more as he grows older.

Once a bricklayer, always a bricklayer. There aren't so many chances to get to be foreman. One foreman can direct a gang of as many as twenty bricklayers. There are fewer chances still to become a superintendent. A chart of the National Industrial Conference Board shows that superintendents and foremen, lumped together with the owners of small establishments and with their salesmen and engineers, constitute all told only 4.5 percent of all persons engaged in mechanical and manufacturing industries.

That gives you a fair notion of how much chance my son, as a plumber, would have to grow up through foreman and superintendent to a business of his own.

But as a college graduate he'll be a brain worker, and won't have to stick to just one routine that he's acquired a knack for. He'll be able to seize any big chance that comes his way. Figures on the graduates of four well-known engineering schools—Lawrence Scientific, Lehigh, Stevens Institute and Towne Scientific—show that between fifty and seventy percent of the graduates, twenty-five years after graduation, are engaged in some pursuit other than engineering. You see, those fellows have been able to branch out. Because they had trained minds they were able to grasp new activities. Not so the plumber. He must go on wiping joints to the end of his days, because such tricks of his trade are all that he knows.

The college educated brain worker may still be going good, well after sixty. But the skilled manual worker has begun to lose his grip before that. I know of men in the building trades who at the age of sixty are having to work as helpers to their own boys!

And talk about a plumber going into business for himself, as a way out of the rut! Well—lately I've seen young fellows trying just that. Not only plumbers, but masons and carpenters who realize that their trade leads them nowhere in the long run. I've seen them set up as contractors, and struggle along for awhile—and fail. They fail mostly because they haven't the education that will help them succeed. They can't figure their costs right; they don't understand about overhead—they can't write good letters, handle their collections in a businesslike way, or make a good enough impression on the business men they have to deal with.

"Mr. Business Man wouldn't stick to plastering very long. It's not the same pleasant exercise that Saturday golf is"

And it isn't lack of ability, always—just lack of the education that would start them off on the right foot.

So that's why I want to send my boy to college. Not to learn Greek or history or science—but to *learn how to learn.*

In a booklet written by Vice President Reeve Schley, of the Chase National Bank of New York, I find a statement that sums up this point very well. Mr. Schley says:

"The principal benefit of a college education is not what one learns in college but the knowledge one obtains of what can be learned in future years. This is the greatest advantage which the college trained man has over the man who has not had the same kind of education."

The practical mechanic knows very well that the science and theory which he hasn't got are more important than the rule-of-thumb details that he has got. When I took up heating and steam-fitting I found I had to learn the theory. When I went into sheet metal work I had to discover for myself that there was such a thing as geometry—and then I had to teach it to myself, which wasn't easy.

If my son is to be where I hope to see him—either running his own business or a salaried executive in somebody else's—why, he's got to have a thorough grounding in theories and principles. He's got to be up on economics, science and history. I've been reading up on this subject, and I find that the opinion is very general among big business men that the college man soon becomes more useful to them than the other man, just because he has both this sort of knowledge and the knowledge of how to find out what he doesn't know.

THE result is that he soon leaves the noncollege man behind. Data published by the Bureau of Education shows that ninety percent of college men are successful in rising to good salaries as against 25 percent of noncollege men. An investigation of the careers of employees in large factories, made some years ago by James M. Dodge, former President of the American Society of Mechanical Engineers, brought out that at the age of thirty-two the graduates of trade schools reached their highest earnings, which were only fifty-eight percent of the earnings of technical college graduates; and that the boys who had only apprenticeship experience reached their maximum at the age of twenty-four, this maximum being only thirty-eight percent of the earnings of the technical college graduate.

On the railroads I understand that it takes the noncollege man on the average twenty-nine years to reach the higher executive jobs, and the college man only twenty-one years. In the railroad supply industry, which I'm told is fairly representative of manufacturing generally, sixty-five percent of the higher executive positions are held by college graduates, and it took these graduates ten years less than the noncollege men to get there.

Figures from a typical big public utility show a similar advantage for the college man—eight to ten years saved in reaching the executive level. I've seen it stated that a survey of the entire supervisory force of the Westinghouse Electric and Manufacturing Company showed approximately fifty percent of the men in these responsible positions were college-bred.

Now the census tells us there are about 33,000,000 men in this country working for pay. All living male college graduates constitute only about nine tenths of one percent of this (*Continued on page 160*)

Hunting Wild Zebras *with* Fishpoles

The Story of a Thrilling Round-Up of Striped Beauties for the Zoo

By THOMAS W. PHELPS

Hooked! A lariat about his neck, struggling zebra is tied to his captor's horse

"KEER! Keer!" shouted the other zebra-hunters to us, meaning "stop him!" Towards us, up the hill, raced a magnificent zebra. Jerry Bouwer, fleetest of the riders, galloped after him, carrying a bamboo fishpole, tipped with a noose of rawhide.

Bouwer, leaning far forward, held the noose almost over the zebra's back. Then his horse fell into a hidden ditch. Bouwer did a short flight, made a perfect three-point landing, and bounced to his feet.

That was my introduction to the South African method of "fishing for zebras," with all its speed and thrills.

In the bush-covered valley of the Little Karroo, twenty miles south of Oudtshoorn in Cape Colony, I encountered seven horsemen carrying fishpoles, who told me they were out to catch wild zebras. Special permission had been given by the administrator of Cape Province, they said, to catch the rare mountain zebras, alive, for European zoos. They needed another man. I joined them.

Three of the riders started off across the valley toward the left, and three more to the right. The two poorest riders—I was one of them—remained to mount the top of a *kopje* between the scouting bands and act as lookouts and reserves.

Our plan was to circle the base of the hills without disturbing the zebras. Their retreat to the mountains cut off, we could drive them toward the plain and run them in circles until near enough to drop nooses over their heads. Each of us carried the curious fishpole, with its rawhide lariat.

From the top of our hill we watched the other horsemen, immersed up to their mounts' bellies in a sea of bush,

"Landing" a frisky zebra colt with rod and line. It's a thrilling game, whose object is to capture the rare animals uninjured for zoos

until they were mere specks bobbing in the distance.

A sudden outcry brought us to our feet. We saw a zebra scudding across a barren stretch of ground just below us. Three horsemen were after him, riding like mad. "Keer! Keer!" they shouted, as Bouwer spurred forward and then catapulted to earth from his stumbling horse.

That didn't stop Bouwer. Bounding to his feet, he kept on running. For twenty yards, it seemed, he actually held his own with the surprised zebra. It darted up the hill toward us.

With much shouting and waving of arms, we turned the animal back. Bouwer, helping his horse out of the ditch, rejoined the chase, in which we now entered. To save our horses we tried chasing our quarry by turns.

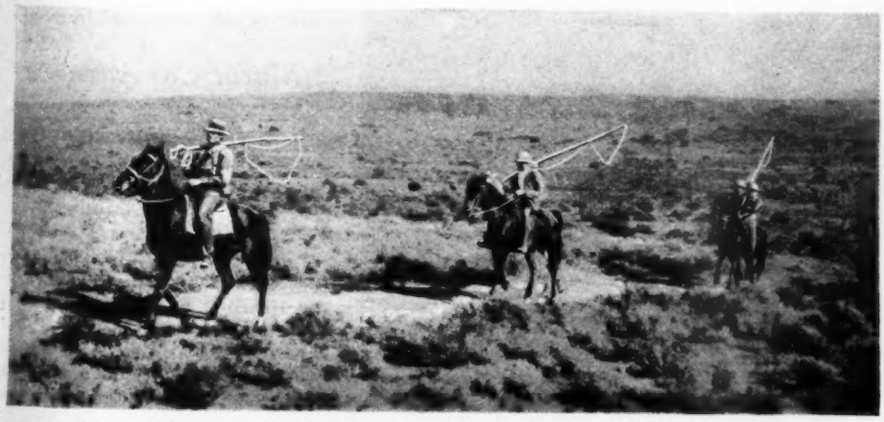
Surefooted as a mountain goat, he seemed to delight in the worst going, taking us through wiry brush and flood-washed ditches. A dozen times we could have ended it all by driving the zebra into a fence corner down the plain, but the buyer had specified that the animals must be delivered alive and uninjured. Bouwer knew that recently another hunter had caught four of the rare animals in a *kraal*, only to see them dash themselves against the walls.

NOW Bouwer's horse was tired—but so was the zebra. A final spurt, and with his fishpole Bouwer dropped the noose over the zebra's head. It tightened. The zebra reared frantically on his hind legs, then bit his captor. Luckily his teeth caught only a piece of flapping trouser leg. He was at once roped to the horse. We drove and dragged him back to camp.

I was fascinated by the novel scheme of "zebra-fishing." "What's the matter with lassoing the zebras?" I asked.

"The zebra is too smart and the ground too bushy," my companions explained. "We imported an American cowboy to try it. We drove a zebra past him eleven times and no matter how hard he tried he couldn't catch it. He couldn't lasso the zebra's legs because of the tall bush. When he tried for the animal's neck, the zebra put its head between its legs or dodged the rope altogether."

But with a fishpole Jerry Bouwer alone has started more than thirty of these wild little animals on zoo and circus careers in various parts of the world.



Three "fishermen on horseback" carrying bamboo poles and rawhide lines, ride across the bush-covered South African valley toward the mountain retreats of the zebras

Solving World's Mysteries

Advancements and achievements in various scientific fields of research and invention, important because of their bearing on the daily interests of life, are recorded monthly on these pages.

Volcanic Island Alters Its Face

ONE of the strangest new discoveries is that of a changeable island which alters its face from year to year. It is Bogoslof Island, owned by Uncle Sam, one of the Aleutian group southwest of Alaska. Dr. T. A. Jaggar, volcano expert, who has been studying these islands for the United States Geological Survey, recently reported that Bogoslof has changed entirely since he last visited it twenty years ago. Among its new features are a lava peak 200 feet high, a lagoon of warm water, heated by volcanic fires, and alteration of former island peaks.

The strange place has been called "the Lon Chaney among islands." Its only inhabitants are hundreds of sea lions and thousands of birds, the latter apparently attracted by the volcanic warmth.

Since the volcanos there continue active, Dr. Jaggar believes the island will keep on changing.

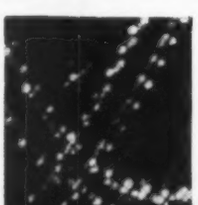
Engines Run on Fish Oil

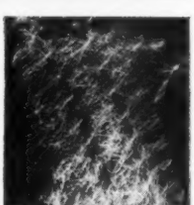
EXPERIMENTS in extracting oil from soil at the bottom of the ocean were described on these pages in the October POPULAR SCIENCE MONTHLY. Now two French engineers, Georges Lumet and Henri Marcelet, claim success in using oil from fishes to run Diesel engines, which ordinarily use petroleum. The heating value of fish oil, they found, was not greatly inferior to that of mineral oils; nor was its burning accompanied by bad odors, as had been expected. The fishy smell of the oil evidently was destroyed by combustion.

When Diesel engines are made in small enough sizes to be used in automobiles—a likely development—the teeming life of the sea may become an important source of motor fuel supply.

New Aluminum Rival

IN THE manufacture of machines and household utensils aluminum soon will have a remarkable rival. The new metal called beryllium, extracted from ores previously dumped away as waste, promises special value in making frames for airships and pistons for automobiles.

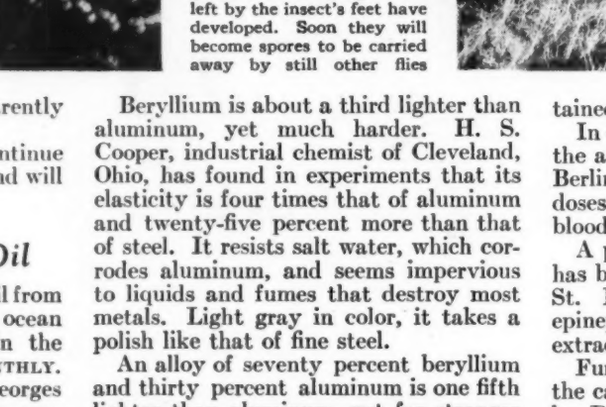




Photographic evidence that convicts the fly of spreading disease is obtained by F. Perry South, London, with an apparatus by which he photographs and magnifies fly footprints. At left, a fly's tracks just made. At right, the same tracks twelve hours later, showing how the germs from decaying matter left by the insect's feet have developed. Soon they will become spores to be carried away by still other flies

Beryllium is about a third lighter than aluminum, yet much harder. H. S. Cooper, industrial chemist of Cleveland, Ohio, has found in experiments that its elasticity is four times that of aluminum and twenty-five percent more than that of steel. It resists salt water, which corrodes aluminum, and seems impervious to liquids and fumes that destroy most metals. Light gray in color, it takes a polish like that of fine steel.

An alloy of seventy percent beryllium and thirty percent aluminum is one fifth lighter than aluminum, yet far stronger than duralumin, the lightweight metal now used widely in airship construction.



While others listen in, Fred J. Shaughnessy, of Rochester, N. Y., a deaf mute since childhood, "feels in" for evening concerts with a diminutive disk-shaped cone speaker, which he devised for his set. He says that the vibrations he feels are music to his sensitive fingers

Beryllium ores, hauled out of feldspar mines in New England by hundreds of tons, have been thrown away as waste. The commonest type is known as beryl, sometimes worn as a semiprecious stone.

Antitoxin Victor Over Erysipelas

IN THE everlasting battle for the relief of suffering, possibly the most important mark of progress during the month is the announcement that erysipelas soon will be added to the list of vanquished diseases. At Bellevue Hospital in New York Doctors Douglas Symmers and Kenneth M. Lewis have met surprising success in the use of an antitoxin for this painful inflammation of the skin. Mortality from the disease has been reduced one half—from ten to five percent. The antitoxin was developed by Dr. K. E. Birkhaug, of Rochester.

"This treatment," reports Dr. Symmers, "marks an advance, the results of which are commensurate with those obtained in the treatment of diphtheria."

In experiments to combat hardening of the arteries, Dr. Hans Guggenheimer, of Berlin, has discovered that very small doses of iodine apparently help quicken blood circulation.

A possible remedy for nearsightedness has been found by Dr. Meyer Wiener, of St. Louis, in the administration of epinephrin, the powerful drug that is extracted from the suprarenal glands.

Further tests of the curative value of the cathode rays from the tube invented by Dr. W. D. Coolidge of the General Electric Company have revealed that exposure of various substances to the rays gives them the power to prevent and cure rickets. Among such substances are brewers' yeast, cornstarch and cottonseed oil. Yeast exposed to the rays for thirty seconds was found ten to twenty times as powerful in its curative effects as cod liver oil.

Motor Car Advance

NEW processes of manufacturing automobile crank shafts that will make new motor cars much easier to break in, prevent wear and reduce oil dilution, were recently described to the Society of Automotive Engineers. Instead of being ground and polished with emery, the crank shafts are by the new method honed like a razor with abrasive stones to make them smooth and true. The honing permits smaller clearances in the bearings, thus materially reducing vibration and wear.

Fish Oil Motor Fuel—Newest Metal Surpasses Aluminum—Music Of Earthquakes Is Studied—Other Scientific Advances of Month

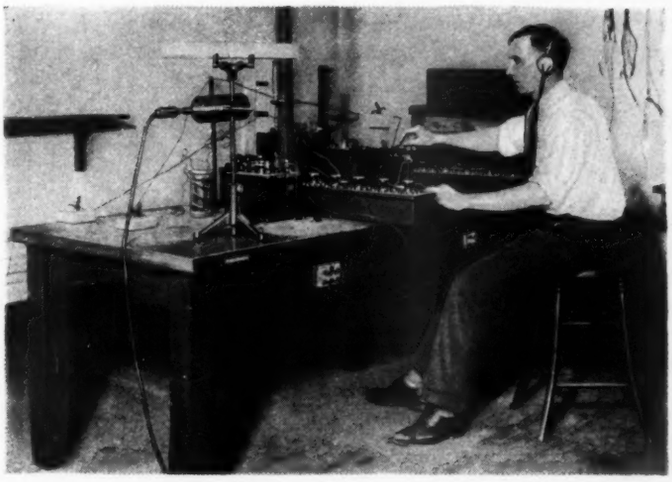
Tiniest Particle May Be Etheron

ARE the electron and its consort, the proton, after all, the ultimate tiniest units of matter? If not, then what is the smallest thing in the universe?

Sir J. J. Thompson, noted British physicist, recently declared his belief that even these infinitesimal electrified particles are divisible into still simpler pieces to be revealed by further study. Present theory holds that every atom of matter is composed of one or more protons, around which revolve one or more electrons. The atom itself is so small that it takes seven figures in fractions to measure it. The electron is 1800 times as small as an atom, and the proton even tinier. Yet even these, Thompson declares, are insufficient to explain all of the atom's behavior.

An answer may be found in the remarkable theory just advanced by Capt. T. J. J. See, U. S. N., mathematician and astronomer. From studies of gravitation, he concludes that the smallest thing is an infinitesimal particle of ether called the etheron. So fine are these ether particles that they freely penetrate the earth.

"If atoms of common gas such as hydrogen, nitrogen or oxygen be imagined the size of lemons, oranges or grapefruit," See explains, "then on this same scale the electron is like a coarse grain of sand, and the etheron is like a fine particle of smoke from a cigar."



A rubber-sulphur compound, believed superior to gutta-percha for ocean cable insulation, is under test by A. H. Scott, a U. S. Bureau of Standards physicist. Placed in iron pipes, it is subjected to 10,000 pounds pressure to the inch. The instruments measure its performance as a nonconductor

Limits Seen for Television

WITH the marvel of television achieved, many of us have believed that soon we shall sit by our firesides and view distant events as they happen, but experts now express doubt that this dream will ever be realized.

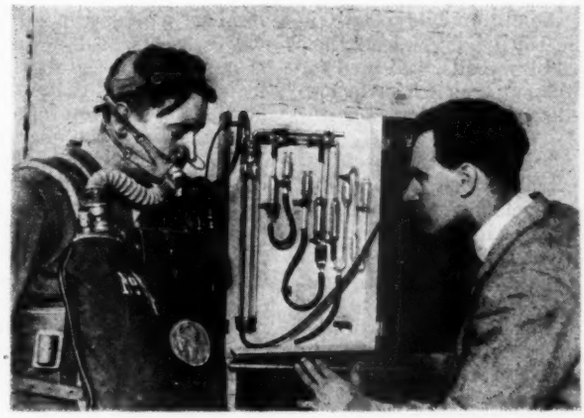
Enormous obstacles, they say, still stand in the way of practical television for everybody. Chief of these is the speed difficulty. The best television apparatus developed by the Bell Telephone Laboratories is able to transmit a clear action picture only about three inches square—far too small a space, engineers say, to portray a football game or a king's coronation. Yet even this requires the transmission of 40,000 dots of light and shadow every second to produce a true effect of motion—sixteen different scenes a second, each containing 2500 dots. Moreover, such a picture now requires elaborate apparatus that would fill a room.

To produce a picture four times larger, engineers say, would require the sending of a hundred thousand separate impulses a second, each reproducing a tiny spot of light or darkness. Such enormous speeds, they fear, may never be attained.

Rain Making Yet Unachieved

POSSIBILITIES of artificial rain making are remote, says Charles Maurain, French meteorologist, in a recent summary of present knowledge on this fascinating question. Only when the atmosphere is already supersaturated with moisture—a rare occurrence—could rain be made, he says, unless some way could be found to agitate the raindrops of a cloud and make them combine into bigger drops that would fall.

Such experiments, conducted by J. Violle with small-scale explosions, have almost without exception proved fruitless. The mighty blasts set off not long ago in France in other experiments caused only occasional formation of clouds.



In a poison gas chamber in London gas masks and other life-saving devices for firemen, miners and soldiers are tested for efficiency. Here a subject inhales pure air from a tank and exhales it into the arrangement of tubes in which it is examined. Later he will inhale gas-laden air through a mask and exhale it into similar tubes. This will be examined and compared with the pure air that was free from gas. Impurities in the exhaled air are identified by their effects on chemicals in the glass tubes and on pure oxygen which is later fused with it

Tides of Blood Present Problem

DAILY tides in blood pressure, heartbeat and other functions of the human body, almost as regular as the tides of the sea, may be caused by mysterious forces beyond the earth, as are the ocean tides. Such is the recent statement of Dr. P. E. Morhardt, French physiologist, who suggests that they may be produced by daily variations in electrification of the air.

It is well known to physicians, Dr. Morhardt points out, that the temperature of the body rises slowly in the forenoon and reaches its height at about four or five o'clock in the afternoon. During the evening it recedes, reaching "low tide" in the early morning. Similar high and low tides at about the same hours are found also in the human pulse rate, in the amount of oxygen used in breathing, and in blood pressure. A strange fact is that the flow of the tides in persons who work at night is no different from that of persons who are active during the day. That sunlight is not responsible is evidenced by the fact, according to Dr. Morhardt, that in northern countries like Iceland, where there is a season when the sun never sets, the same rhythm of bodily tides persists. Either mankind has daily tides in bodily functions, or some external cause is affecting us all in the same way.

Earthquakes to Order Next?

A NOVEL way of exploring the mysteries inside the earth recently was suggested by Doctor R. B. Sosman, of the Geophysical Laboratory, Washington, D.C. He proposes to produce artificial earthquakes by setting off small explosions, somewhat as has been done in France, or by dropping heavy weights on the ground. By measuring the speed and intensity of waves thus produced in the rocks, he believes it will be possible to determine the earth's interior structure.

New studies of earth movements by Paul Kirkpatrick have led to the curious suggestion that the destructiveness of an earthquake may be determined by the "music" it produces—that is, by the pitch of its vibrations, corresponding to the pitch of a musical note. In most quakes, he points out, the earth vibrates back and forth many times, like a piano string. Just as the deep bass notes of an organ will shake the windows of a church, while high treble notes have little effect, so a slow low-pitched earthquake may knock down more buildings than a high-pitched one that vibrates rapidly.

Whirling Wheels

By EDMUND M. LITTELL

Illustrated by B. J. Rosenmeyer

The world was reeling. Gil struggled to his feet . . . "Where's Wally?" . . . . Over there men were running toward a motionless bundle of something. Wally

A Novel of the Automobile Age—In This Installment, the Most Thrilling Race Story You Ever Have Read

IN THE great Game of Speed, as in the Game of Love, Gil Herrick and big Jim Wenden were bitter rivals. The feud dated back to the early days of the automobile when Gil, a young mechanic, and Jim, the town bully, raced their crude motor-wagons over Michigan country roads, and vied for the hand of a beautiful girl, Gail Caswell. It grew when the two matched their wits later in the gruelling competition of automobile manufacture.

Emerging victor in the Game of Love, Gil found himself engaged in a desperate struggle for survival against his powerful adversary in the Speed Game. In the development of the automobile, both men had attained positions of influence—Jim, by financial manipulations that were often shady; Gil, by long hours of discouraging labor in developing his own mechanical ideas. Through disappointment and adversity Gil was saved from ruin only by his own dogged grit, and by the loyalty of men who rallied behind him—Mac, the chunky Scotch foreman; Wally Burns, the tow-headed machinist; Andrews and Morton, the salesmen, and Oliver H. Marston, the banker whose financial aid he had won.

Jim, thwarted in his attempts to destroy him, challenged Gil to settle the question of speed at the coming Vanderbilt Cup races; at the same time flinging the drunken boast that at last he had "got" his old rival. Now read on:

THERE followed months during which Gil's attention was directed to one thing—the construction of a racer. No one knew how much that machine cost. He had a private account set up for it, and kept it to himself. And what a car that was!

Two years before, the Herrick plant had begun to use drop forgings wherever possible. Spring shackles, connecting rods, valves, gears—there was one transmission set that had four gears forged integral with the shaft; a roll forging—even the little bell cranks that were parts of the throttle and spark connections were drop-forged. Phosphor-bronze castings had been all right when the quantities ordered were small; patterns cost considerably less than the great dies that had to be cut in steel blocks for use in huge drop hammers. But now Gil was using drop forgings—and going to even greater expense. He was using the new alloy steel on the racer.

Alloy steel as such was not new. A great deal of nickel steel, from one to five percent, was manufactured and used; for gears, mostly. There was even some tonnage of Krupp steel—chrome-nickel analysis—imported from Germany. But the new steel, chrome vanadium, had not been used before in America.

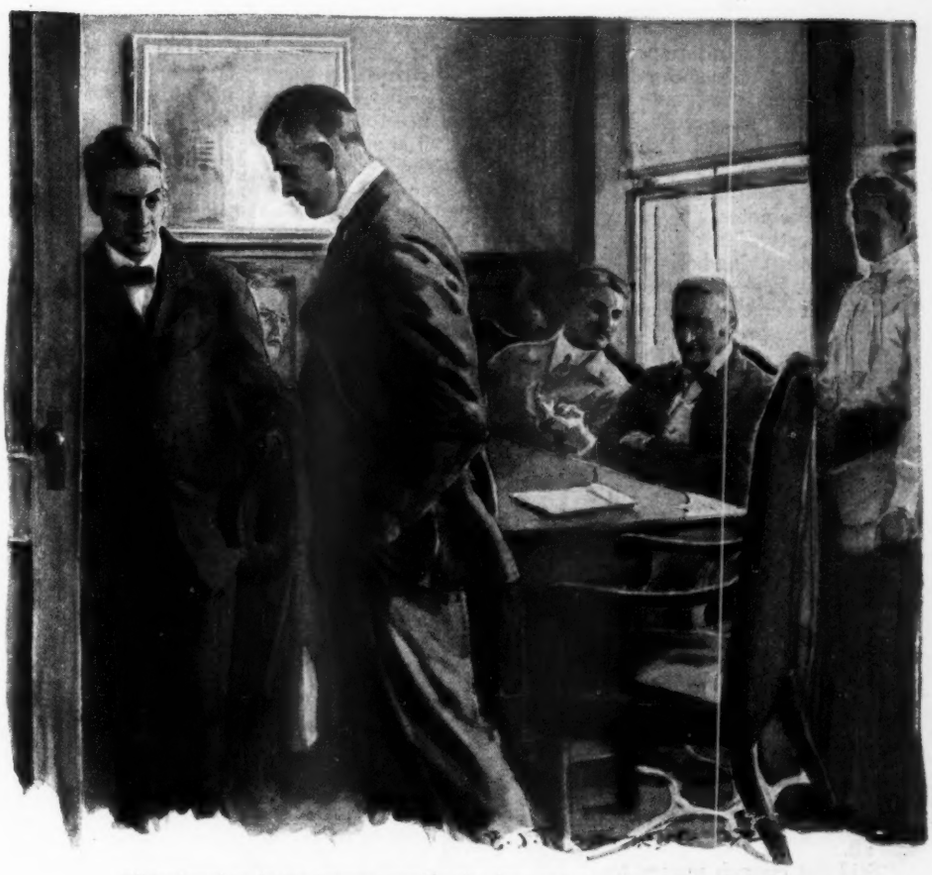
One small mill had had the courage to undertake its manufacture, and was doing it right, though progress was slow. It required special care for special steel, with specially trained men to introduce it. It involved too many additional costs for ordinary shop equipment to handle it. Heat treating furnaces had to be installed, pyrometers, quenching tanks; the greatest care had to be exercised in all its heating. Shops were reluctant to undertake it, but not Gil Herrick. He saw the double, triple, even quadruple strength that could be attained, the toughness that was almost unbelievable. The stuff just wouldn't crystallize and break, and Wally Burns in the service department knew

how much trouble that would save.

That was the steel Gil Herrick used, with furnaces, tanks, electric thermocouple thermometers and all. He made springs, gears, crank shaft, even connecting rods out of that steel, and followed the suggestion of a mill man as to what carbon content to put in the various places—ninety carbon in the springs, fifty-five in the gears, forty in the shaft and rods. He hollow-bored the crank shaft and rods to reduce weights. And he put on extra brakes.

ALREADY he had increased the braking capacity, with drums on the rear wheels besides the old transmission brake; now he enlarged the faces of his drums and installed a new woven asbestos lining. He even discussed the idea of putting drums on the front wheels, but gave it up as unnecessary. To reduce weight a little more, he made the transmission and crank cases of aluminum instead of cast iron, and hollow-bored the drive shaft. All to beat Jim Wenden.

Winter melted into spring, spring warmed into summer, and a racer began to roar along the roads out Mount Clemons way, with Gil at the wheel and Wally Burns beside him. Squatted low in the bucket seats, with the steering wheel so raked that it was in Gil's lap, and Wally with a hand pump which brought oil from the tank behind and forced it into the engine. Some of Jim's men clocked a mile in forty-five seconds once, but that was all they could get. And Gil—he made no slightest effort to find out what Jim was doing. Until it was too late.



Gil hastened to do the honors, opening the door and standing aside. "Glad you came, Jim. Come again," he said. "See you at the Vanderbilt Cup"

Oh, Jim had a racer, all right. It was running the roads out Dearborn way, for his factory was on the other side of town. And he was driving it, too. But that wasn't the thing Jim was most interested in, it developed. He disappeared from town for a couple of days, and came back with a grin on his face and a devilish twinkle in his eye, but said nothing except, "Still driving, is he?"

Gil was. And paying little attention to anything else those days. The lure of speed is an insidious thing; it gets into the blood like wine; so that he failed to see what was going on in the rest of the world. They all told him. Bob Legg said money was getting tight; Andrews and Morton said the car wasn't selling as fast as it should. Wally Burns had an indicator in his department—they were not shipping out as many spare parts as usual, which meant that machines weren't being used. And Oliver H. Marston . . .

"Gil, my boy, we're in for mighty hard times. Better climb out of that racer of yours and take a few reefs in your sails."

There was so much of earnestness in those words, and they came from such an authority, that Gil turned away from the drug of speed and bent his attention to balance sheets, sales reports, and liabilities. Too late.

DEALERS weren't remitting as they should. Cars were in their hands, and when pressed for settlement they all said they could not sell cars, so they had no money. All over the land bankers were growling. "Too much money going into these luxuries; too many automobiles. People can't go on mortgaging their homes to buy them; it must stop." Hence mortgages were a drug on the market, and people with ready money were frightened at the clouds on the financial horizon, and hanging on to what they had. Panic was in the air.

But even so, Gil laughed. "What is a panic?" said he. "A state of mind, that's all. Everybody thinks hard times—and that's what we get. This business is not dead; the automobile is not a luxury. We'll go on. No matter what the bankers say—with apologies to you, Mr. Marston."

And that worthy gentleman shook his head. When it came to banking he was a banker, not a friend. He had some stock in the Herrick outfit, and he was hanging on to it, but . . .

"Whether we are right or not, there is a scarcity of money that is growing worse. We're in for mighty hard times. I hope you can save yourself, but there are many automobile companies . . ."

"That would go on the rocks anyhow," interrupted Gil. "But we'll pull out. Just because Jim Wenden would get a laugh if we didn't."

That was the mood when their annual stockholders' meeting took place, with gloom-ridden men sitting about the long directors' table in Gil Herrick's spacious office. Even Gil felt the depressed morale of those men and experienced a little of it himself. His treasurer, Morton, had a miserable statement; his sales manager, Andrews, a worse one; Mr. Marston's face was almost haggard, for a big New York bank had just failed and he was in desperate straits along with every other banker—and big Jim Wenden walked in!

GIL jumped to his feet. "What are you doing here?"

"Attendin' a stockholders' meeting," grinned Jim.

"By what authority?"

"The same kind you had at the A. L. A. M.," said Jim with a "what-do-you-think?" sort of an air. "Stock, bought and paid for, with cash money—got any in your bank, Gil?—an' a few lovely proxies. I collected 'em while you were gettin' ready for a race."

He tossed a thin bundle of slips on the polished table, and Gil picked them up. So *that* was why Jim had teased him into a race! Gil's good friends in Wendenville had been persuaded to sign their stock over; the ones who had stood by him so staunchly in those earlier days.

"All but your father's, I see. You didn't dare to talk to him about it, did you?"

Jim shrugged. "Well, there's enough," said he. "They agreed with me, you were spendin' a little too much time an' money on racers an' such. They haven't had such an awful lot of return on their investment, an' they agreed with me it might be well to have a capable receiver—excuse me, gentlemen. Perhaps I better wait until our worthy president calls this meetin' to order before I get busy."

If ever a man's mind was chain lightning in a pinch, Gil's was during the next few minutes. Several heads around that table, too, began to take serious thought. Four of those heads

bent over pads of paper that were placed before each seat; four hands extracted fountain pens and wrote busily. It was not until afterward that they showed what they had written to Gil; each written slip was a resignation, to take effect immediately. They were signed by Macintosh, Legg, Andrews and Morton, each of whom had a number of shares that was much too small to be of use in such an emergency. The meeting having been put in session, Gil's plan was laid. He turned to the secretary who was ready to take notes.

"Miss Foster," he said, and there was a light in his eyes that promised something besides surrender, "will you be good enough to take this key—" handing her one which he selected from a ring—"and get the envelope that is marked 'Emergency' that is in my private drawer?"

Miss Foster—she was the same light-haired lady of uncertain age who had been his original office force—took the key and started to leave the room.

"Wait a minute," growled Jim. "You're delayin' this meeting."

"Maybe you'd like to run that errand yourself, Jim," Gil suggested with a grin, "but it can't be done. There's only one person here who knows just where that drawer is. Miss Foster—"

"There, honey, I won't race any more. . . . If I'd only listened!" Tears rose in his eyes

SHE left, and Gil leaned back in his chair with the grin still in evidence. He was the only one of them all who appeared to be at ease.

"How's the racer coming, Jim?"

Some sort of mutter, that was all.

"Still got enough money to buy a set of tires for it?"

No answer.

"Well, ours seems to be able to cover the roads fairly well—ah, here's Miss Foster. Thank you."

He took the bulky white envelope that she handed him and hefted it absent-mindedly, as one would test the feel of a baseball bat—or a club.

"Now," he said—to Jim Wenden and no one else—"this meeting is ready to discuss any matters that may come up. I suppose we'll have to have the minutes of the last meeting read before we can continue." They were read and approved. "And the treasurer's report. This should be very interesting to you, Jim; make you feel at home."

It was an abysmal thing, that report, and Jim laughed when it had been finished and approved, then called for the floor. But before recognizing him, Gil made a little speech.

"Gentlemen, in so far as dollars and cents, assets and liabilities are concerned, this company appears to be insolvent. But it has something that very few organizations have—" with a sharp glance at a frowning Jim. "It has the loyalty and devotion of some of the finest men this game has developed, and not a few of them are sitting around this table. This company will pull through. There would be no need for me to mention that fact if it were not for our unexpected guest. Now—" his hand fell as if by chance on that bulky envelope, "there are other things this company has. Well, not this company, to be exact; myself. But what I have belongs to this company. I have been accused of failure to tend to my knitting," with a glance at the worried Mr. Marston. "I have no doubt been accused of many other things—such as throwing in a pair of suspenders. But I have not been asleep, gentlemen, nor is building a racer the only thing I've done."

He stopped, and looked into each face. He got a grin from some of them, too, for they had a hunch by this time that something good was coming. There was an assurance about G. W.; a definite purpose was written on his lean face. It was as legible as the two sharp lines that creased his cheeks. Something was about to break. They listened expectantly as he talked.

"Did you ever play with dominoes, stand them up on end close together?" He illustrated with the envelope, holding it upright on the table. "And then did you ever push the end one? What happened?" Plop! the envelope fell flat with a sound that almost made them jump. He was looking directly at Jim Wenden as he did it, and Jim's gaze dropped—to that envelope. "No need to answer; it's a foolish question. But it illustrates something. If this company topples, within twenty-four hours another one—and who knows how many besides?—will go down with it. I have papers here—Mr. Legg there will bear me out—that will set in motion certain legal proceedings—pardon me; I'm talking too much. Mr. Wenden, you have the floor."

"You haven't told me what's in that envelope."

"Nor do I intend to. It is marked 'Emergency,' and like a fire hose, it's for use—not conversation. What was it you wanted to say?"

For a long minute Jim Wenden stood there in silence. "Seemed like a week to me," said Andrews afterward. "But when I saw him begin to crumple—" Which is exactly what Jim Wenden did. In little, tiny ways. His eyes wavered, the grin that had been on his face faded, the jaw line seemed to soften, and the out-thrust chin pulled back. Little signs, underscored by what he said: "I'll listen," and Jim sat down.

Here was where they expected Gil to laugh, but he did nothing of the sort. Instead, with that envelope turning over and over in his hands, he glanced about the table. "Is there any other business to come before this meeting?"

And red-headed Andrews covered himself with glory. No one else thought of it at the time; they were all thinking that the meeting must be adjourned while there was a chance. But he got to his feet and added what might be termed an insult to injury.

"Mr. President," and Gil bowed silently. "There seems to be nothing of importance sufficient to deserve this body's further consideration. But before I put my motion I want to express, for those gathered about this table and all those stockholders who are unfortunately not able to attend, the feeling of confidence in our president that I am sure everyone has. (Cries of "Hear! Hear!" from all of them—except Jim.) Every stockholder in this company has implicit faith in the ability of our president to steer the company through this time, and the best method of expressing such faith is to make a motion for adjournment with that understanding. I therefore so move."

EVERY man there seconded it, and the motion was carried without a dissenting vote, for Jim had got up with a sickly smile on his face and was walking toward the door. Gil hastened to do the honors, opening it and standing aside.

"Glad you came, Jim. Come again. See you at the Vanderbilt Cup." And after he had closed the door upon a broad back he made a little saluting gesture with his hand. "You're welcome to the T-head motor," he added.

"What the Sam Hill did you have in that envelope?" cried Andrews, then, and Gil walked back to the table and opened it, while the whole bunch gathered round. There were a few stock certificates of the Wenden Motor Car endorsed in blank, but that was all. There were no legal documents whatsoever.

"If you'd asked me what I made out, I'd ha' been stumped," laughed Legg.

"But I didn't ask you," grinned Gil. "No, what I had in there was a man's conscience," he went on. "Jim hasn't been playing fair, and he didn't know I knew it. He also failed to ask me to prove anything on him—which I counted on. He has been using company funds on the Q. T. to buy control of some other companies. More trust stuff, see? (*Continued on page 153*)

Aviation *Needs 10,000* Young Men

Flying Only a Step Toward Better Places as Designers, Engineers and Transport Chiefs

By CALEB JOHNSON

WANTED: Ten thousand young men to qualify for positions in aerial transportation service.

THAT'S a want ad which hasn't been printed; but it sums up the needs of commercial aviation in America.

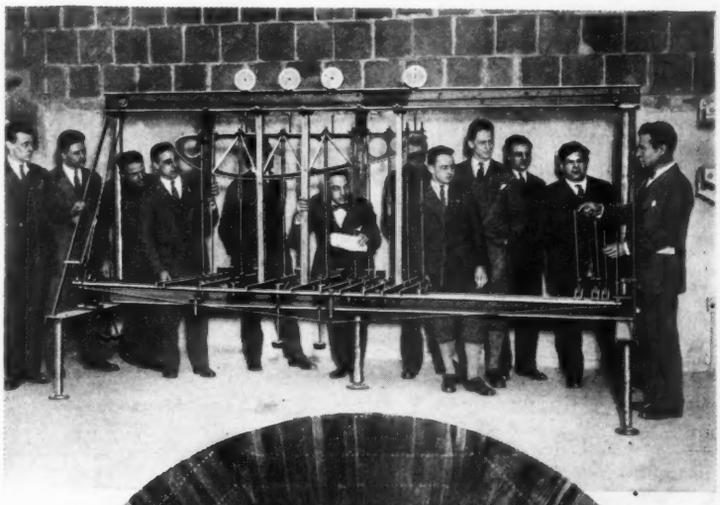
Now, don't crowd, young fellows. There's plenty of time. Nobody has ten thousand jobs waiting to be filled—yet. Read that ad again. It says "to *qualify* for positions."

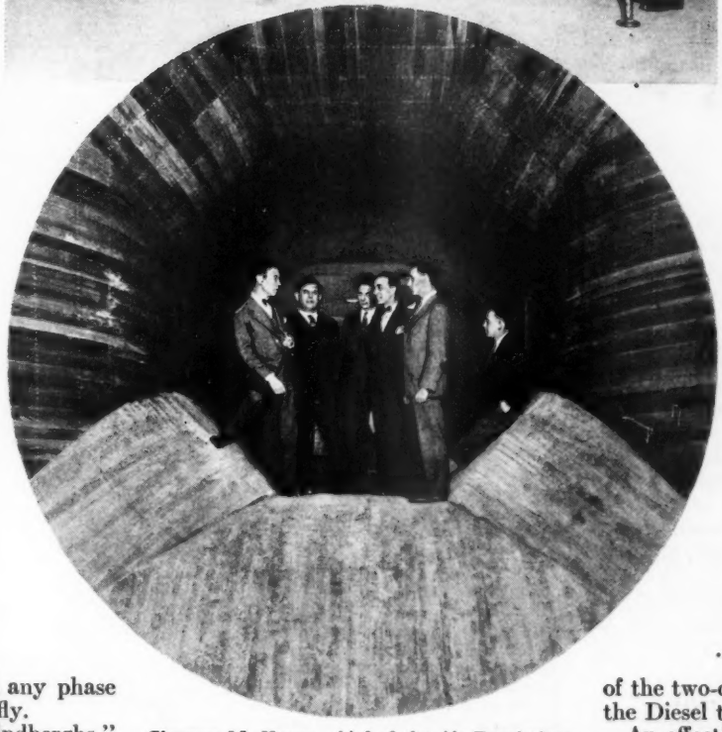
There are a few jobs ready now—for the men who can find them. That means men who have unusual initiative, vision and enthusiasm. For the specially qualified man in certain branches of the science and art of aviation there are other definite needs. But if the public interest in commercial aviation continues to grow, there will be a big demand for qualified men a year from now and in five years the ten thousand young men who will begin to qualify now will come into their own. It will take them from one to five years to qualify, and the jobs will be ready by the time they are.

That is what all the airplane designers and engineers and operators of air services I have talked with agreed upon. All put the emphasis on something besides flying, but all said that everybody having to do with any phase of aviation ought to learn to fly.

"They all want to be Lindberghs," said Frank Russell, vice-president of the Curtiss Aeroplane and Manufacturing Company. "Right now there are more good pilots than there are good planes for them to fly. But there is an immense field of opportunity in aviation, outside of being pilots."

"Just piloting a plane is a chauffeur's job," said "Merry" Merrill, chief instructor of the Curtiss Air Service. "Anybody can learn to do it, but the big chances in aviation aren't in being a pilot. What are all the war 'aces' doing for a living now? Are they pilots? Eddie Rickenbacker isn't, for one. And Lindy certainly isn't going back to pushing a plane over a mail route. Everybody ought to learn to fly, just as everybody ought to learn to drive a car. But the proportion of those who earn their living by piloting planes is going to be about the same as that of those whose main job is driving a car."





Clarence M. Young, chief of the Air Regulations Division, U. S. Department of Commerce, is shown at the extreme right in the upper photograph explaining an airplane vibration testing machine to students on a visit to the Guggenheim School of Aeronautics, New York University. At his right is Prof. Alexander Klemin, director of the school. In the lower photo Young, Professor Klemin and students are inspecting wind tunnel for testing planes

There are plenty of interesting and profitable things a chap can do with an airplane, but for the great majority who go into commercial aviation the big opportunities are on the ground. "Get it out of people's minds that aviation is merely an adventurous kind of sport, and into their minds that it is a more rapid means of transportation, and we will begin to get somewhere in the development of air transit," said J. W. Miller, Secretary of the Daniel Guggenheim Fund for the Promotion of Aeronautics.

There is the key to the big opportunities in aviation. Transportation—carrying something, people or goods, from one place to another. Building up of air organizations, development of ports, charting of lines of travel, improvement of aircraft—these are the things that some of the biggest men in the country, commanding big money, have decided shall be done. The new opportunities lie in helping carry out this program.

Let's start with the improvement of airplanes. I asked a dozen or more experts what airplane inventions or improvements were needed. Here is the list I gathered.

A METHOD of making duralumin noncorrosive when exposed to salt water; or a new alloy equal to duralumin which will not corrode.

Simpler engines of equal or greater reliability with the best now made; perhaps of the two-cycle type, perhaps engines of the Diesel type, using low-grade fuel.

An effective muffler for the engine exhaust, which will not reduce the power output.

Better protection against fire; perhaps a noninflammable "dope" for fabric-covered planes.

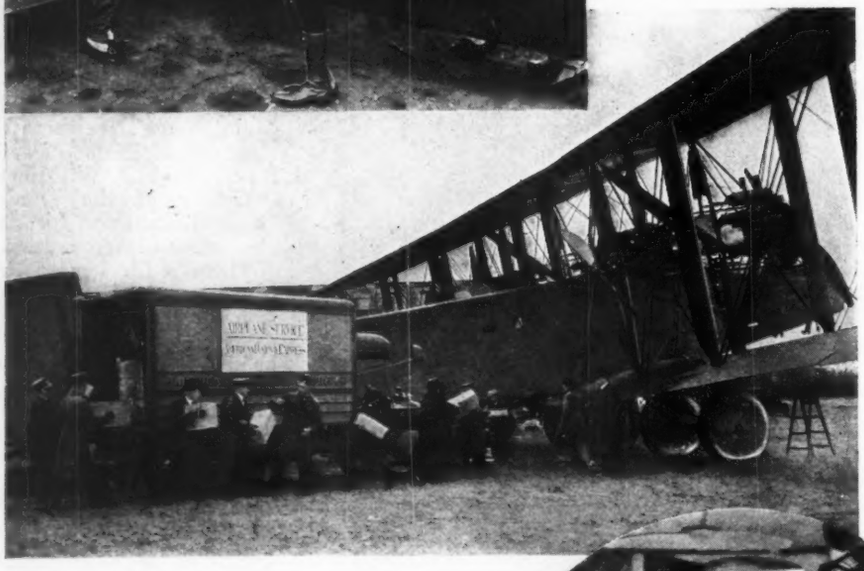
Improved parachutes and other safety devices.

Radio apparatus with longer range and of lighter weight.

All agreed on one outstanding need of aviation, which offers the widest field for inventive effort—improved design. Somebody must—and somebody will—build ships which will land at thirty-five miles or slower, use not more than 300 feet of space for landing and take-off, maintain flying speed as low as thirty-five miles an

Sixteen young women make the Chicago Women's Flying Club the largest class of aviation students of the fair sex. Mrs. E. Lewis Campbell, president of the class and an instructor (in white), is seen bending over the controls, giving some members points in management of a plane under various conditions

A rather interesting sight now—a commonplace one in five years. An airplane being loaded on the outskirts of New York with hundreds of pounds of express matter consigned to Chicago. This is the means of transport when speedy delivery is wanted



hour and gliding speed not much greater, and be so stable in the air as to return automatically to correct flying attitude when subjected to sudden wind currents. Those are the ideals of performance set up as a standard to aim at in the competition for the Guggenheim prize—one of $100,000 and five of $10,000 each—which is open for competition until the end of October, 1929.

The airplane that wins the $100,000 prize may look entirely different from any plane now being flown. Dornier in Europe and Henry Ford in America have announced huge planes carrying 100 passengers for the near future. I asked Prof. Alexander Klemin, Director of the Guggenheim School of Aeronautics of New York University, whether such huge planes were practicable.

"THE larger the planes themselves, the less need there is for the tail," he said. "I would not be surprised to see a big plane developed without any tail at all; I think that is the direction in which we are moving."

In the development of new plane and engine designs and of the different items I have listed, the opportunities are unlimited for the young men who will begin to qualify now. And the way is open to qualify. That way is to study aeronautical engineering in one of the five great schools which now give thorough courses by aid of Guggenheim grants—New York University, Massachusetts Institute of Technology, the University of Michigan, Leland Stanford University and the California Institute of Technology.

Air motoring de luxe. A waiter serves light luncheon and liquid refreshments in one of the huge twenty-passenger planes on the London-Paris route—service that will in a few years be duplicated or surpassed by many air lines now projected in the United States

Four years of hard work in college, and the summers spent in airplane factories and in learning to fly—with that preparation there are jobs waiting for you now and there will be many more four years hence.

"All of our graduates have found places at once in aircraft factories," Professor Klemin told me. "They have started in at salaries ranging around $65 a week."

That is a good deal more than the average young engineer, just out of college, gets in any other line of industry.

"We take the aeronautical engineers from the M. I. T. as fast as we can get them," said Russell of the Curtiss company. "The construction of a modern plane is not done under the supervision of just one engineer, but of many, each a specialist in one particular phase. After we had finished the wind tunnel tests of models for the *Condor*, and agreed upon a design, the construction was delegated to ten engineers, each charged with designing one particular part. And on a plane designed to weigh, with full load, some 16,000 pounds, the finished job was only sixty pounds heavier than we had calculated."

Electrical engineers are needed in the industry and thousands more will be within five years. The young man who begins to qualify in electrical engineering now, with a special eye to the electrical problems of aviation, has a chance like those which Edison, Tesla and Marconi found and made their own. Only an electrical engineer like Morris Titterington could have conceived and designed the earth inductor compass, which enabled the trans-Atlantic flyers to find their way across the ocean and which will be an essential part of the equipment of every future long-distance flight.

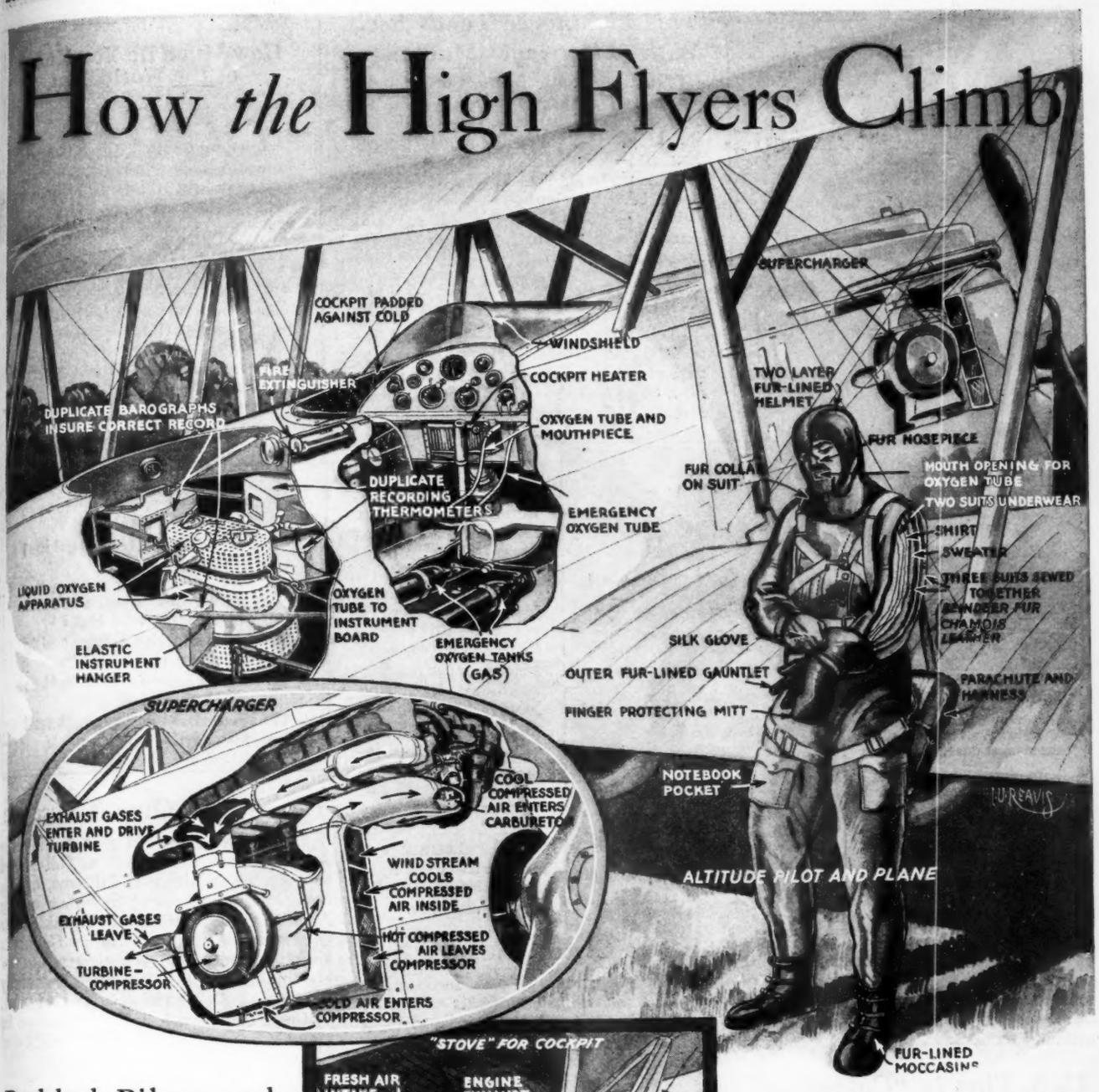
ELECTRICITY in some of its applications holds the solution of the problem of safe flying and landing in fogs, which are the most serious handicap to aviation today. I asked Professor Klemin how he thought the problem was most likely to be solved.

"Somebody may find a means of dispelling fog by electrically charged sand strewn from a plane, with which experiments have been made," he said, "but so far nothing practical has come of this. For the present we must depend upon improvement in field lighting and in radio signals. I believe it is possible to devise a means of making light audible, so that invisible rays of the lighting systems of airports and intermediate fields will be

(*Continued on page 142*)

The whirling chair tests a Guggenheim-New York University student for fitness for the flying unit. After the whirl Major I. B. Marsh examines the subject as to pulse and dizziness. If he passes this examination and others he is fit to fly

How *the* High Flyers Climb



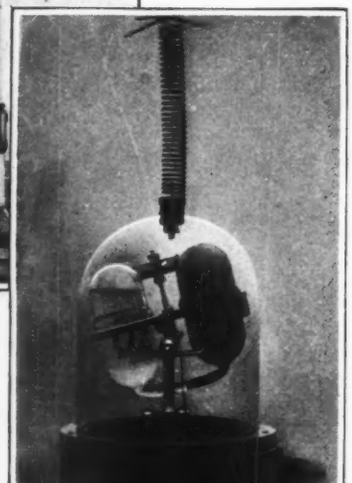
Padded Pilots and Engines Get Oxygen Artificially in 83 Below Zero Region

OUR artist illustrates here the clothing and equipment of an altitude flyer out for a record jaunt above the clouds. The information on which the pictures are based was supplied by the Materials Division of the U. S. Army Air Corps.

The pilot faces blasts of air, as cold as eighty-three below zero! He cannot breathe it, for it contains too little oxygen; between his lips is a tube from a tank of liquid oxygen, rapidly flashing into gas under the reduced pressure. The engine carburetor's "lungs" gasp for air; a supercharger crowds it in.

At great heights the pilot's senses are dimmed. Automatic instruments—the recording thermometer and the recording barometer, or barograph—must bring back whatever record he has made. Two barographs are sealed before the take-off by a representative of the International Aeronautical Federation, world governing body of air records. When the machine descends the barographs are unsealed and the height attained is computed.

The large picture shows altitude pilot with plane and equipment. In the thin upper atmosphere the supercharger, shown in oval, whirls 20,000 times a minute, giving the engine air at sea-level pressure. Against temperature as low as 83 below zero, exhaust-heated stove, in the oblong, warms the cockpit. Gelatine on four-ply goggles, in circle, prevents ice forming on them. At bottom left and right are instruments that record atmospheric conditions, indicating altitude



Red lights at center warn when automatic light fails. At right: Valve that turns beacon on at dusk, off at dawn

This Lighthouse Tends Itself With Electrical Machinery

THAT romantic figure, the old lighthouse keeper, is missing from the New Heugh Lighthouse, most modern of its kind, just opened at Hartlepool, England—for this light keeps itself.

The powerful beacon is electrically operated. An engineer visits it once a week to clean and inspect it. If anything goes wrong, red lights appear on the shoreward side to call for repairs.

Ultra-Violet Window Panes

NOW that "ultra-violet glass," designed to admit the health-giving rays of the sun, has been perfected, its use on a large scale has already commenced. Hotels and apartment houses in New York, Chicago and elsewhere have now adopted the material for windows, and even zoos are following suit. Hospitals and schools have installed them.

Recently the American Medical Association tested several "ultra-violet glasses" placed on the market. It found four that looked like ordinary glass that admitted freely both the invisible health rays and visible light. Others, apparently black to the eye, allowed penetration of the ultra-violet light that ordinary window glass bars.

Speeding Bullets Can Be Filmed

FROM Germany comes news of a new motion picture camera, just perfected, that can take 48,000 pictures a second. It will be used to photograph flying bullets, electric sparks, and vibrations of machinery—things far too swift even to be registered as a passing blur by the ordinary camera.

U. S. First in "Calamities"

IN A unique "report of world calamities" of last year, just presented to the Geographic Society of Geneva, America led the list with twenty-five. Italy was a close second with twenty-one. Most of the "calamities" were floods or great storms; there were in all ninety-eight floods and seventy-five cyclones, tornadoes or typhoons. The United States topped the storm list with fifteen.

Thirty-one earthquakes were reported, of which two in the United States were severe enough to be included. Here, also, occurred one fire and one avalanche. Two of Russia's calamities were famines.

Wrist Watch Winds Itself

YOUR arm's natural movement is reported to be sufficient to keep a new wrist watch going as long as you wear it. It winds itself; half an hour's wear is sufficient for forty hours' time-keeping. A small weight within the mechanism swings whenever the watch is moved, turning the winding spring.

Steam Clears Rails of Ice

SPECIAL snow-fighting locomotives have been adopted for this winter by several Eastern railroad yards to clear the switches of snow. The engines are equipped with nine pipes, arranged in a "V" just behind the cowcatcher, to spurt live steam directly beneath it and melt the hardest snow and ice. One large railroad has twenty-five of its locomotives equipped for this duty.

Another way of keeping switches clear of snow is that recently adopted by a New York elevated railroad. It has built into the switch rails automatic electric heating coils that operate whenever the temperature falls below a certain point.

Mystery in Electric Vapor

A FAINTLY luminous ball of blue vapor, rising from the filament of an electric light bulb, is a mystery that has recently puzzled Dr. Joseph Kaplan, physicist at Johns Hopkins University. In attempting to obtain atomic hydrogen in a large glass bulb, he passed the low-pressure gas over a lit filament and, on extinguishing the light, noticed the odd phenomenon. The vaporous ball spread into a glowing cloud and disappeared. The light was too faint to observe with the spectroscope in further experiments to find out what causes it.

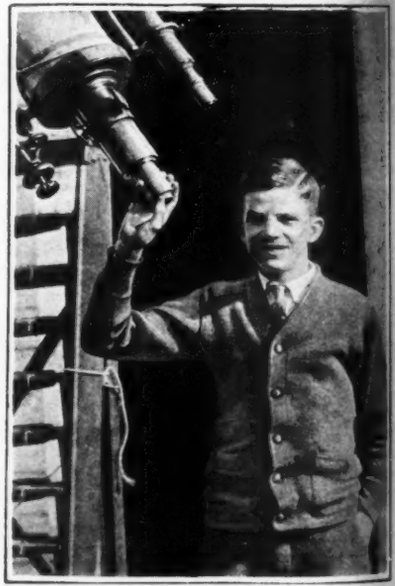
How Much Do You Know of the World You Live In?

TEST your general knowledge with these dozen questions, chosen from hundreds sent in by readers. Correct answers are on page 164.

1. What is "skittles"?
2. What fertile region of the earth is very sparsely populated?
3. On what tropical island is irrigation necessary?
4. Why is one of the best harbors in western North America entirely unused?
5. How is agriculture possible in Arctic Alaska?
6. Where is most of the iron ore produced in the United States?
7. What parts of America are below sea level?
8. What is the International Date Line?
9. Where do women wear long coils of wire around their arms and legs?
10. What is the longest ship canal in the world?
11. What language is spoken by the most people?
12. Where is the greatest wall ever built?

Boy Builds Own Telescope

FIFTEEN years old and having the distinction of being a full-fledged astronomer is Richard Williams, of San Jose, Calif. Youngest member of the American Association of Variable Star Observers, he is the only California astronomer to send monthly reports of his findings to the Harvard University Astronomical Division. Williams, pictured below with a huge telescope he made himself, plans to get his Ph. D. and to make a life work of astronomy.



Youngest member of American Association of Variable Star Observers: Richard Williams, aged 15, who reports discoveries to Harvard

Know Your Motor Car

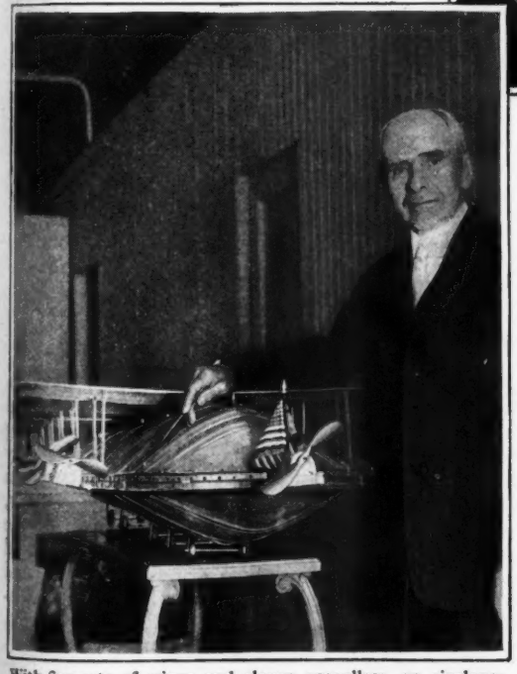
A SPEEDOMETER is an indispensable motor accessory—the only check you have on oil, gas and tire mileage. Yet many automobile owners don't give speedometers the care they need. The head of the speedometer, which houses the mechanism, should never be tampered with, but you should lubricate the drive shaft every few thousand miles. Unscrew the knurled nut that holds the upper end of the shaft to the head and squirt transmission oil into the hollow sleeve around the links that make up the shaft. A properly lubricated shaft will last much longer.

The constant jarring tends to impair your speedometer's accuracy. Have it tested after each five thousand miles.

Half Plane Half Dirigible

FIVE hundred passengers would be carried by a proposed airplane-dirigible that would dwarf the largest flying machines in existence! Its curious bloated hull, 786 feet long, would inclose 4,500,000 cubic feet of gas, making it only slightly heavier than air. The rest of its weight would be carried by five sets of wings each 200 feet long!

Eleven motors are designed to drive as many propellers, flying the ship 150 miles an hour. It could take the air and land at slow speed by virtue of its hybrid balloon feature. A trip from America to Europe would require fifty-two hours, says its inventor, Claude H. Freese, of San Francisco. His model, shown below, is based on his twenty years' experience in the Zeppelin works in Germany.



With five sets of wings and eleven propellers, an airplane-dirigible 786 feet long would carry 500 passengers, according to Claude H. Freese, its designer, pictured here with his model

Thermos "Food Trolley" Carries Hospital Meals

LIKE some giant thermos bottle, a new heat-tight box is now used as a "food trolley" in Bolingbroke Hospital, Wandsworth Common, London. Insulated compartments side by side within the box keep hot foods hot and cold things cold en route to the patients. The three-wheeled container, shown leaving the kitchen, has convenient handles that guide it down long corridors.

Mica the Versatile Mineral

CHRISTMAS tree "snow" and imitation granite surfacing for stucco walls are among the varied products made from mica, the transparent mineral that windows the peephole of your furnace. Huge quantities of the sheet-forming mineral, valued for its resistance to heat and electricity, are used in radio condensers and other electrical apparatus. For its resistance to shock, it is used in motor goggles and in conning towers of warships. Its resonant qualities adapt it to diaphragms of phonographs.

Most of our mica is imported, India producing half the world's output. Here, New Hampshire is the leading producer of sheet mica, and North Carolina of fragments known as scrap mica.

Safety in Hub Light

HERE'S an unusual lamp that shows you the right-hand side of the road when you drive at night regardless of glare from the headlights of an oncoming car. It keeps you from running off the road, and shows just how much room you can give the other fellow. You can dim your lights so that they will not blind him without reducing your own vision.

The position of the lamp—on the hub of the right front wheel—is made possible by drilling a hole in the hub cap and attaching the lamp bracket to the axle, which does not turn. It throws a bright beam of light just where you need it—directly in front of the wheel. When the wheel is turned, going around curves, the light follows it.

Heat-tight and cold-tight "food trolley" leaving kitchen in Bolingbroke Hospital, Wandsworth Common, London, with food to reach patients either piping hot or freezing cold

Electric Eye Runs Factory

A NEW use for the photo-electric cell—a sensitive device that transforms changes in light intensity into electric fluctuations—has been found by a Kalamazoo, Mich., paper mill. One of these cells is placed beneath the continuous roll of paper that travels through the factory, and automatically adjusts the machinery when the paper is getting too thick or too thin. The difference in the amount of light transmitted by the paper sets the device in operation.

Sharks Die in "Sea Desert"

IN THE south Pacific Ocean has just been discovered the most desolate spot in the world. According to Dr. Austin H. Clark, who helped chart it for the Smithsonian Institution, the place is devoid of any kind of life—either in the surface waves or at the bottom. No region on land is comparable with its lifelessness. Ear bones of whales and teeth of sharks on the red clay bottom are the only remains of sea monsters that strayed into the "sea desert" and perished.

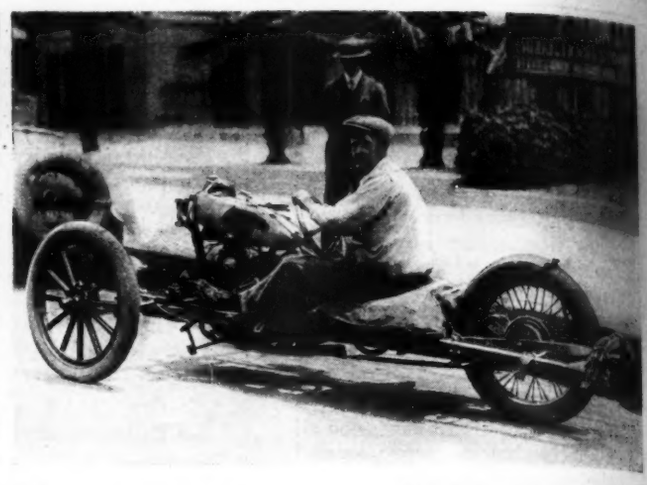
Color Photography Nearer

NATURAL color photographs on paper are brought nearer by a new process in which yellow, blue and red prints from separate negatives are made in succession upon a single sheet. The tones are obtained by an ingenious choice of color-forming chemicals used to sensitize the paper before each printing.

Trees Fight for Lives

TREES are continually fighting for their lives. There are 200,000 known varieties of insects that attack them.

Reminiscent of the first "horseless carriages" is this motor car built of junk. It is seen being turned around by its novel steering system of pulleys



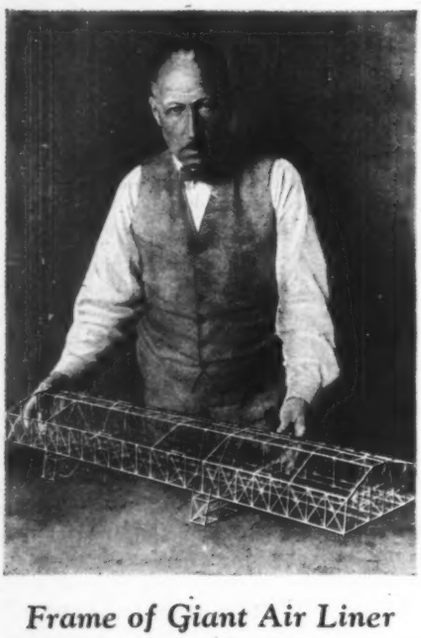
The $18, homemade, three-wheel motor car of Gayle Lockhart, which, with its low-hung construction, is said to make 65 miles an hour safely

Autos Built at Home of Junk, Resource and Ingenuity

WHERE there's a will to have an automobile there's a way, even if there is not so much cash. Two men have recently become motor car owners at costs of fifty cents and $18.

With half a dollar's worth of junk, Kenneth Shand and Billy Van Zant, California boys, put together a machine that actually runs—with one of them at the wheel and the other shifting gears! It is steered by a novel system of pulleys.

Gayle Lockhart, of Los Angeles, built his car at a cost of $18, using motorcycle and automobile parts. He claims speed of sixty-five miles an hour. Despite its swiftness, the three-wheeled machine is said to hold the road well by virtue of its low-hung construction.



Frame of Giant Air Liner

MORE than a hundred passengers will be carried by a giant air liner which Herr Rumpler, noted German airplane builder, says he will construct. It will have a crew of thirty-four. The illustration shows the designer with a model of the duralumin framework to be used in its construction.

Wave Lengths of Elements

AT A new subterranean laboratory of the U. S. Bureau of Standards, the wave lengths of all the chemical elements will be measured for a permanent record of each substance's properties. No two elements have exactly the same wave lengths when the light from hot samples is examined with the spectroscope.

This identification enables workers to detect minute impurities in metals where chemical analysis fails. With the wave length charts astronomers can determine what stars are made of.

Previous studies at the Bureau have measured the wave lengths of most known substances, including the new element hafnium, so rare that it is almost impossible to obtain.

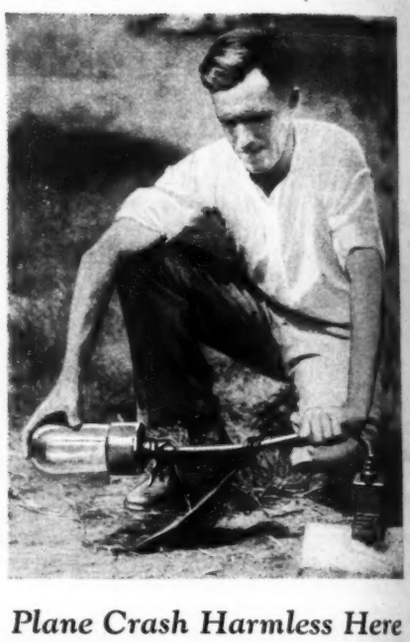
A Bridge That Alters Shape

THE world's longest concrete "bowstring" girder bridge, it is said, has just been completed at Bagneux, on the outskirts of Paris. Its 286½-foot arch alters its shape under heavy loads and temperature changes. One end is pivoted upon its supports while the other can slide forward or back.

Noisy Oysters Spoil Survey

DESPITE their proverbial reputation for silence, oysters recently forced the U. S. Coast and Geodetic Survey to change its plans for charting the Atlantic shore between Cape Hatteras and Cape Lookout, N. C. To determine accurately the position of the survey ship, underwater sound waves were to be used, as elsewhere; but when the delicate acoustic instruments were made ready, they registered only the clicking "static" of oysters opening and shutting their shells.

Joint experiments by the U. S. Bureau of Standards and the Coast Survey developed the sound wave method. When the survey ship explodes a miniature "depth bomb," underwater sound waves reaching several shore stations in turn automatically flash back an instantaneous radio signal. With a map and a stop watch the ship's officer can thus determine his distance from each shore station and hence his exact position —wherever oysters are not too numerous!



Plane Crash Harmless Here

PLANES need not fear running afoul of a new type of landing field "blinker," invented by W. G. Fuller of the Municipal Airport at Fort Worth, Texas. Its standard is flexible, and should a plane run into it, only a broken lamp globe will result. The old type lamps were mounted on rigid standards, and several planes making night landings were damaged. Other fields in the Southwest are adopting the new lights.

Earth's Speed May Vary

THAT the spinning earth, like the average man, has its lazy days and slows down now and then, later making up for lost time, is the remarkable theory recently advanced by Prof. Benjamin Boss of the Dudley Observatory, Albany, N. Y. This, he told members of the American Astronomical Society, would account nicely for errors that he found in the Greenwich Observatory's calculations of the earth's speed. These errors, which were noted also by Prof. E. W. Brown of Yale University, had been ascribed by him to repeated minor inaccuracies of observation.

Traffic Paint Endurance Test

HOW long will a white traffic line stand up under heavy traffic? To find out the best kind of paint, the U. S. Bureau of Standards recently used a dozen samples to mark a Washington, D. C., street. Those that withstand the friction of countless automobile tires will be adjudged the best.

"Hot Dogs" Capture England

NOW the "hot dog," famed American article of diet, has spread to England, and through promotion efforts of a newly formed syndicate in London is attaining wide popularity. To satisfy the British Board of Health, wax containers for the familiar sausages and rolls have been adopted. Reports say that the English "hot dog" appears in the highest society at sporting events, a prestige unknown to its democratic American cousin.

Trees Cast "Radio Shadows"

QUEER facts about extremely short radio waves were discovered during recent tests on a five-meter transmitter of the General Electric Company to find its applicability in aviation. So great was the waves' frequency, it was found, that the ripples traveled in straight lines like light beams. Trees, buildings or hills intervening between the transmitter and the receiver cast "radio shadows," or "dead spots" within which no signals could be heard.

Rubber Horseshoes

RUBBER shoes for horses and mules are rapidly gaining favor, and the U. S. Department of Agriculture advises their use to protect the animals' feet wherever necessary. Shock of hard pavements is reduced and the new shoes are "ready-to-wear," a convenience in the present-day scarcity of blacksmith shops. On treacherous surfaces the rubber horseshoes are said to be "nonskid."

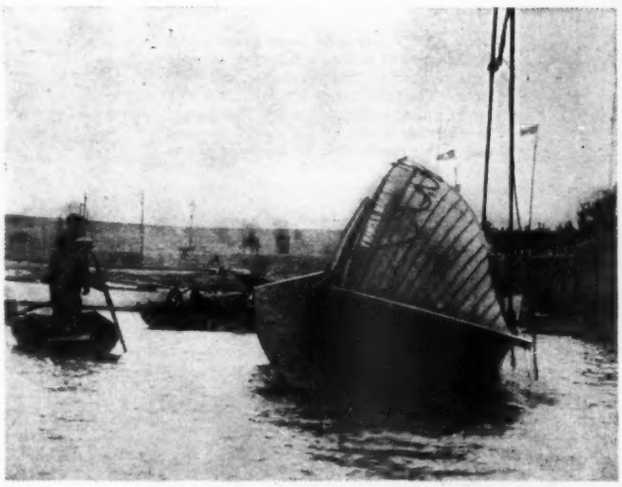
Native Foods Best

EIGHT vegetables that were first grown here by the Indians now produce crops more valuable, according to the U. S. Department of Agriculture, than those of the whole twenty-four important ones that we have imported and domesticated in this country. The original American vegetables, raised by the red men, were beans, corn, peppers, pumpkins, squashes, tomatoes, potatoes and sweet potatoes.

From the Old World first came the cucumbers, eggplants and muskmelons that we are accustomed to see on our table. Watermelons, okra, asparagus, beets and Brussels sprouts are of European origin, as are cabbage, carrots, cauliflower, celery, kale and collard, and kohlrabi. Among other foreign vegetables are numbered lettuce, leek, onions, parsley, parsnips, peas, radishes, salsify, spinach, and turnips.

A Boat That Can't Capsize

A BOAT within a boat is the unsinkable life-saving craft recently demonstrated at Belfast, Ireland. Even if a wave should tip it completely over, the passengers would remain dry, it is said, for the inner chamber is so hung that it always remains level. Within the smaller craft is a mechanism for righting the outer shell whenever this happens. In the illustration below the new lifeboat is being deliberately tipped over; the swinging compartment that carries the occupants is retaining its upright position.



The inner compartment of the life-saving boat remains level, as shown in the picture, when the outer shell is tipped over, which is being done here in a demonstration. Mechanism is provided to right the outer part

Bicyclist Has Trailer to Carry Children

IT'S easy to take the children for an airing when you know how! A Frenchman devised this novel trailer to be attached at the back of his bicycle. Now he piles his youngsters in the wide carriage seat, buckles them in with a strap, and pedals along the boulevards.

A Window-Envelope Contest

JUST what makes a good window envelope—the sort with a transparent strip to read the address inside—has recently been studied at the U. S. Bureau of Standards. Such envelopes, made by impregnating a space on their front with oil or varnish to make it transparent, were found satisfactory if kept cool and dry, though separate "windows" of "glassine" paper were more permanent. Objectionable gloss, likely to cause eyestrain, was measured with a "glarimeter"; the transparency, and liability to crack when folded, of the windows were also determined for various materials.

New Air-Mapping Invention

BY THE use of an entirely new system of air mapping, Dr. Reinhard Hugershoff, German cartographer, hopes to be able to revolutionize the art. He plans to demonstrate his invention at Washington, D. C., where Government officials who are considering remapping the whole United States will provide him with an airplane, an expert pilot, and a photographer to try his scheme.

Special stereopticons would project his airplane photographs on a large drum, where they would show a "stereoscopic" effect that would instantly differentiate hills and valleys, he explains. Starting at a single point of known elevation, a contour line could be drawn touching all points equally high. Extensive land measurements would be unnecessary; Dr. Hugershoff says that his system requires only three actual measurements for every 65 miles.

New Products *of the*

How to Tame Balky Wires

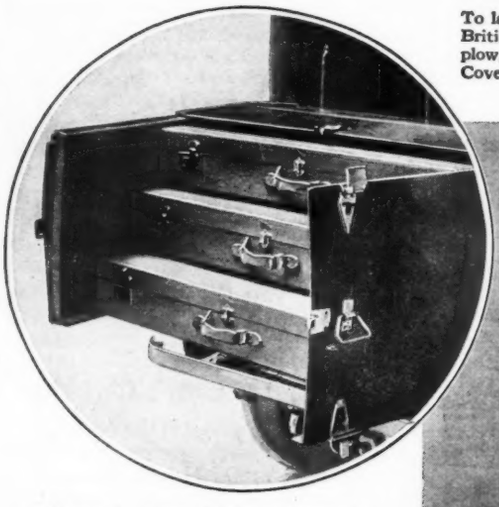
To pull an unruly electric wire through a wall a new tool reaches in and grips the wire end between its two viselike halves

Plow Lays Radio Wire in Furrow

To lay ground wires for a broadcasting station the British Post Office attached a reel to a tractor-drawn plow, which unrolled the wire into its own furrow. Covering the wires with earth was quick and easy

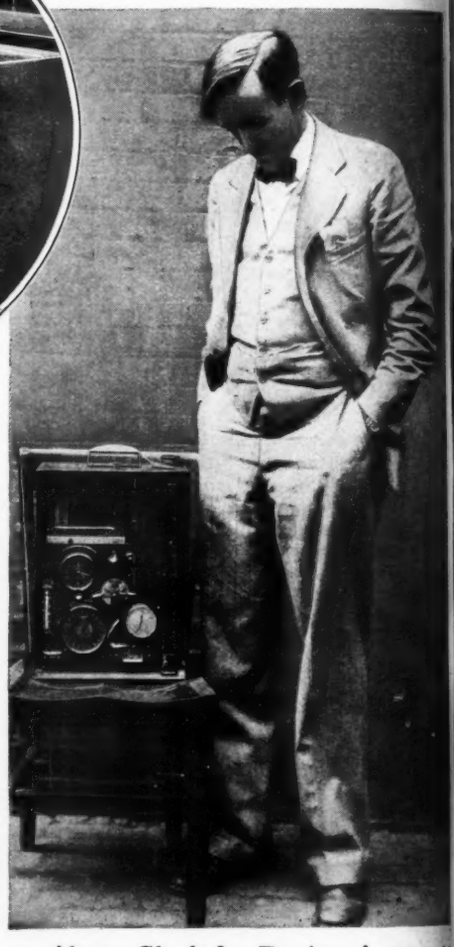
Ratchet Gives Bicycle High Speed

The ratchet drive of the bicycle invented by Rene Bigarre, of Paris, allows the pedals to be worked up and down instead of around, saving time and energy, it is said. Fifty-mile-an-hour speed is easy



Three-in-One Motor Trunk

A touring trunk for three persons or one incloses three cases arranged like drawers in a chest. When desired they may be used for ordinary travel as suitcases, being provided with a lock and handle



Alarm Clock for Dozing Aeronauts

With an altimeter or height register built into it, this clock will let a balloonist sleep and wake him if his craft sinks below a set point. When the altimeter reaches the danger point it sounds an electric buzzer and if the ground is approached it flashes a light signal. The device operates regardless of fog or other atmospheric conditions. Ward T. Van Orman, the inventor, himself a balloonist, is shown in the picture with his machine, which has been tested successfully

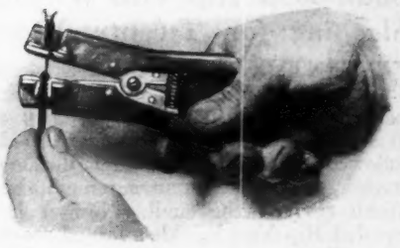
Glass Violin String Case

Long glass tubes have been invented in Illinois to save violin strings from damage by moisture or bad atmospheric conditions. The tubes, shown below, fit into a larger tube, so it is easy for the player to examine them all at one time and select the one which he is ready to use

Lightning Shorthand Typewriter

A new French shorthand typewriter prints standard characters on a tape at 200 to 250 words a minute, said to be fifty percent faster than the ordinary method. Light in weight, as the picture shows, the machine has twenty-one keys and can be operated with one or both hands. It is now in use in the Paris courts, the Chamber of Deputies and many of the offices

World's Workshops

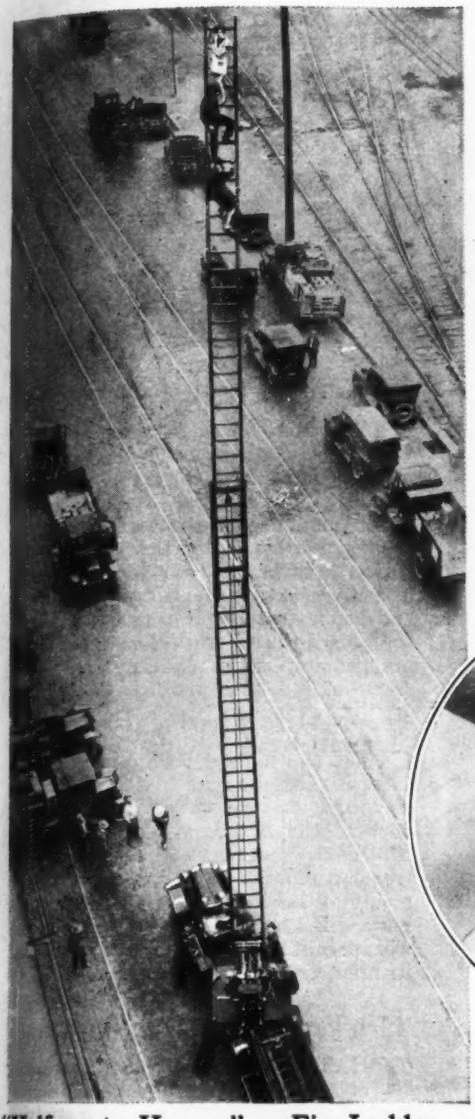


Machine Skins Wire in Hurry

Time is saved in taking insulation off an electric wire by the machine at the right. Close the plierlike handles and one set of jaws grips the wire; the other, with notched knife blades, strips the coating off clean

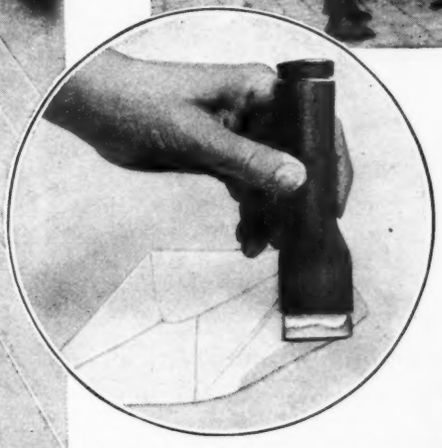
Dustless Street Cleaning at Last

Berlin has devised a street cleaning car whose operation does not scatter clouds of dust into the air. Mouths of the refuse cans fit into openings in the revolving bin. When it turns their loads are dumped in. When the dust is settled they are removed



"Halfway to Heaven" on Fire Ladder

No place for a person who gets dizzy is the new extension ladder these young women helped the Los Angeles firemen test. Despite its fragile appearance, it is quite safe

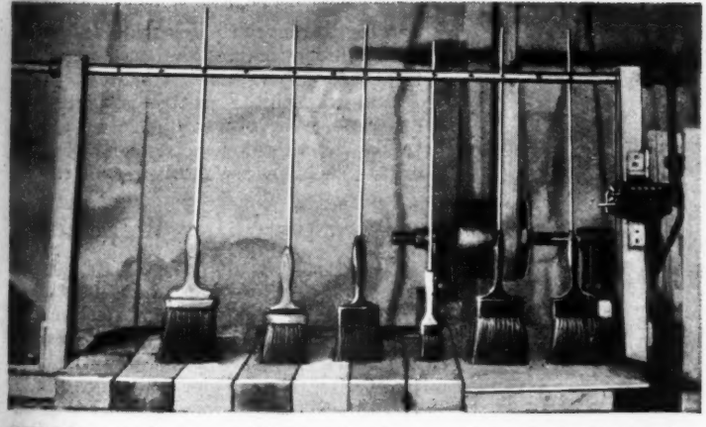


New Economical Label Licker

In the business end of this English label and envelope licker is a piece of felt. When it is applied the pressure releases water from the reservoir in the handle into the felt. When the pressure is released the reservoir is closed

A Mirror That Tells Your Height

This remarkable mirror, installed in a Portland, Ore., store, has a scale so placed that the figure at the point where your eyes are reflected gives your height. The arrangement is possible by reason of the fact that the elevation from the eyes to the highest point of the head is almost exactly the same with all persons, regardless of height. The device has proved correct so far



Machine Tests Paint Brushes

To test their life and endurance, a Wooster, O., paint brush plant attaches its brushes to a revolving shaft, which makes them do millions of strokes, which are counted automatically

Snail Is a Rip Van Winkle, Sleeping for Twenty Years

TWENTY years of continuous sleep! That is the amazing slumber mark held by a land snail, the property of Walter F. Webb, of Rochester, N. Y. It followed another ten years' dormant stretch, terminated one summer when Webb revived the snail. Now it has equaled Rip Van Winkle's fabled record and still seems able to sleep indefinitely.

Copper Hardened for Knives

FAR from being a lost art, as many suppose, the hardening of copper is daily practiced by modern metallurgists. Copper scissors, knives and other cutting tools are used in a few places where they possess special advantages over steel. Alloying and "cold working," the two methods used centuries ago, are still employed successfully; a recent new way of hardening copper is by the addition of silicon, a nonmetallic chemical element, to copper-containing alloys.

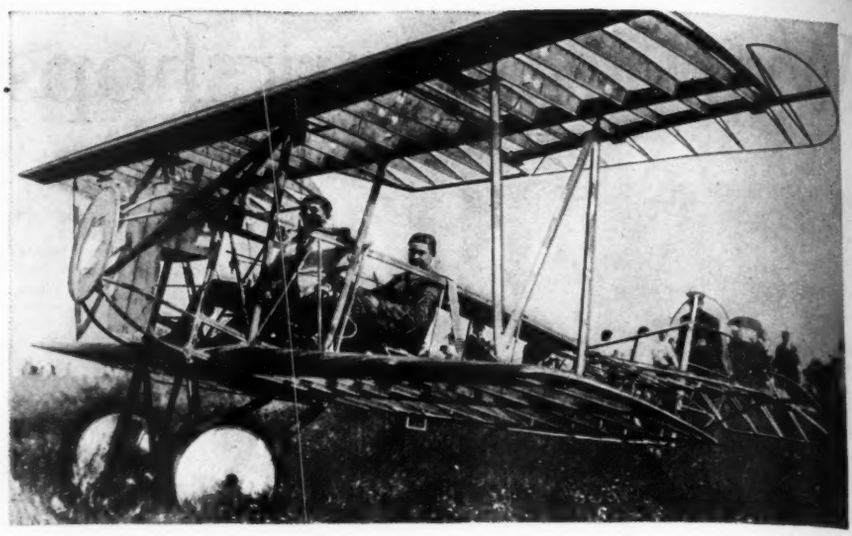
Lion "Packs" Hardest Punch

THE impact of a lion's paw, the flip of a whale's tail, and the kick of a giraffe are said to be the most powerful blows that animals can deliver. The lion's is the most forceful, upholding his title as "King of Beasts."

Lunch Wagon Trails Patrons

"FOLLOW the trade" is the motto of a novel lunch wagon, and it observes it literally by rolling itself to wherever the trade is liveliest. It is a motorized coffee stall, which appeared recently on London streets. Its specialty is catering to the night workers and the theater-goers, many of whom do not wish to buy expensive dinners at a restaurant, but just a cup of coffee and a sandwich.

The advantage of the motorized lunch stand is its mobility, by which it can move in a few minutes to whatever section demands its trade. In all other respects it is neat and modern and just as attractive as those of its competitors which are rooted to their foundations.



Champion Woman Nail Driver

DID anyone say a woman can't drive a nail straight? Some can't, perhaps, but not Mrs. Benjamin F. Rennard, champion woman nail driver. She won a recent contest at Philadelphia in which thirty women competed. Each drove five nails into a plank; Mrs. Rennard took the shortest time.

Wherever night workers finish their shifts or theaters dismiss their audiences in London the motorized coffee stall rolls up to serve the crowd. It solves the problem in districts where there are no restaurants and in those where there are only cafes that are hard on slim pocketbooks

Skeleton Plane for Novices

WOULD-BE fliers soon learn the inside workings of a plane with the aid of this novel skeleton craft, used for the instruction of German pilots. All the parts can be seen in operation, and the student can master the "how" and "why" of the controls long before he actually takes to the air. He sits with the demonstrator in the cockpit and tests for himself the effects of the various levers and gears upon the plane's parts.

Two-Mile Bridge Projected

SOON the longest bridge in the world will cross an arm of the Baltic Sea, according to reports from Germany, to connect the island city of Rügen with Stralsund, on the mainland. It will traverse more than two miles of water, making it the longest railroad bridge ever built. Its hundred-and-five-foot height will permit heavy boat traffic beneath its nineteen long spans.

Crickets Chirp Temperature

THAT crickets are vocal thermometers is the astonishing conclusion of Bert E. Holmes after a four-year study of the insects. You can tell the temperature, he says, by timing the frequency of their chirps. His formula is: "The prevailing temperature in degrees Fahrenheit equals the number of chirps made in a quarter of a minute, plus thirty-seven." This remarkable way of telling the temperature, the reason for which is imperfectly understood, is said to be accurate to about one degree.

"Snowy white" or tree crickets, another observer points out, are the ones to use as thermometers. The common cricket's chirps are more irregular.

Industry Shifts Westward

AGAIN the center of industry of the United States has moved westward. The latest survey of the Department of the Interior finds a spot about fifty miles southeast of Chicago is now the midpoint of industrial development.

The real, or geographic, center of the nation lies near the middle of Kansas' northern boundary. The center of population is in Owen County, Indiana.

Sprinter's Sprinting Family

FIVE children of Arthur Duffey, of Boston, first sprinter to run 100 yards in 9⅗ seconds, show promise of following in their daddy's athletic footsteps. This sight may be seen on roads near Boston almost any morning.

Under the coaching of Duffey, Arthur, Jr., oldest, has achieved something of an athletic record at Arlington Junior High School, Boston, in football, baseball and hockey. He can run 100 yards in eleven seconds, although only fifteen years old. John, Helen Louise, William and Roger, reading from left to right, all show promise.

X-Rays Speed Evolution

IF RECENT discoveries of X-rays' effects on fruit flies, made by Prof. H. J. Muller, of the University of Texas, prove true for other creatures, he will have speeded up evolution a hundred times! Under the rays the flies' offspring include an extraordinary number of freaks, or "sports," with modified characteristics—wings altered or body of unusual shape.

Such sports occur in Nature, but very rarely. They are believed to be the founders, by evolution, of new races. Cattle breeders select such individuals, if they are superior, to improve their stock. Professor Muller has suggested a speeding up of Nature that may be applied to the entire animal world.

"One Way Windows" Invented

BY ADDING to glass extremely thin films of gold, an English inventor, S. Cowper Cowles, has recently found a means of making "one way windows." They are said to be transparent and of a pleasing greenish color to a person looking out, but one trying to look in sees only an opaque burnished gold panel.

A Theater Curtain of Water

WHEN the curtain is due to fall at an outdoor theater recently completed in Philadelphia, they turn on the water! The descending liquid wall, from an overhead pipe at the front of the stage, forms an effective and beautiful screen. Colored lights play upon the waterfall while the "curtain" is "down." To "raise" it, the water is simply shut off and the stage is again visible.

World's Smallest Scissors

THE miniature scissors shown in the photograph above have been produced by a Los Angeles manufacturer, who calls them the smallest working shears in the world.

The blades, which are less than an inch long, are of good steel and may be used for fine cutting that is impossible for shears with larger blades.

Ready to Breed Supermen, Says Noted Gland Expert

BY THE transplantation of glands, Dr. Serge Voronoff, noted surgeon, proposes to create a race of supermen! In a recent amazing address to the Zoological Congress at Budapest, Hungary, he told of his successful experiments with aged rams whose lives he had prolonged, and whose offspring yielded more wool.

"Give me children endowed with the spark of genius," he said, "and I will breed a race of supermen. The mother who is the first to hand me her child for a rejuvenation operation perhaps would be the founder of a new and mighty human race."

Building a Hippopotamus

THE first lifelike mounted hippopotamus to grace a museum, on display at the Field Museum of Natural History, Chicago, is really not a hippo at all! The peculiarity of the hippopotamus' skin, taxidermists say, makes it appear unnatural when it is preserved. So Leon L. Walters, the museum's taxidermist, and inventor of a celluloidlike substance that he had to use to model snakes, molded from the skin of a real hippo a "celluloid" reproduction. This "synthetic hippo" is said to be superior to the genuine; not only does it deceive the eye, but it is more lifelike and a better object for study.

A Church on a Chassis

A MOTOR car once used by liquor smugglers has been converted into the rolling church or "Gospel Patrol" shown in the photograph below with Lawrence E. Greenwood, evangelist, at the organ on the extension platform at the rear of the vehicle.

Greenwood started his work at Wiscasset, Me., where a tabernacle was built and many foreign missions were sent out. Then the minister acquired the chassis of a rum runners' car and built upon it the unique rolling church, with which he tours Eastern states, visiting not only cities, but tiny communities having no churches of their own.

Into the highways and byways goes this Gospel Patrol, built on the chassis of a car once used by bootleggers. Lawrence E. Greenwood, of Wiscasset, Me., the minister, is shown at the organ, which is carried inside and brought out onto the extension platform when services are to be conducted

Gigantic Water Lilies

THE largest and most beautiful water lilies grown are claimed by the Georgia Experiment Station at Griffin, one of whose gigantic blossoms is exhibited here. The flowers are not only far beyond normal size, but they have a delicacy of texture and faint coloring that is said to be unequaled.

Macready May Win Record

THAT America, through Lieut. John A. Macready's flight of last year, may hold the world's altitude record for airplanes is the consequence of recent charges by the Aero Club of France against Jean Callizo, French flyer. The club expelled Callizo and voided all his records, including the world's record of 40,820 feet, on apparent proof that he "faked" a barograph chart with invisible ink to show a new record in his latest flight. Another barograph, concealed in his plane by a Bleriot engineer, registered less than 14,000 feet.

Should the International Aeronautical Association, world aviation authority, support the French Aero Club's action, the world's record will revert to Macready for his 38,704-foot ascent.

Fertilizer Made of Cocoa

IN RESPONSE to the demand for a fertilizer of nonobjectionable odor, the U. S. Department of Agriculture, through researches by its Bureau of Soils, has developed a new, pleasantly fragrant soil enricher. Obtained as a by-product in the manufacture of cocoa and chocolate, it contains valuable agricultural ingredients that remain after the food substances are extracted. Moreover, it has the aroma of a newly opened can of cocoa.

Chicago-Mexico Air Mail

NOW arrangements are nearly completed for an air mail line from Chicago to Mexico City. Harry S. New, United States Postmaster General, is devoting his efforts to the establishment of this latest link between the nations.

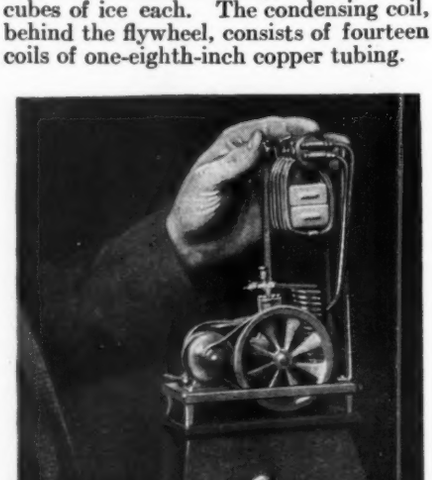
Aviation progress in Mexico has been rapid; recent lighting facilities have made it possible for Mexican pilots to fly at all hours of the night as well as by day.

Nickel-in-Slot Soda Water Dispensed in Ten Flavors

NICKEL-IN-THE-SLOT soda fountains have been invented by F. E. Gray, of Philadelphia, who has just put them in operation there and arranged to do so elsewhere. Not unlike the coffee slot machines in operation, the new devices provide ten flavors. Caretakers at intervals put in ice and take out nickels.

Tiniest Iceless Refrigerator

TINY cubes of ice are frozen by the smallest refrigerator in the world—a remarkable model built by L. S. Cooper, of Piqua, O., pictured below. An exact copy of a popular make of iceless refrigerator, the miniature device is only eight inches high. Half an ounce of sulphur dioxide is used as the cooling liquid gas, and one of the valves moves one sixty-fourth of an inch to open and close. The two diminutive trays make twelve cubes of ice each. The condensing coil, behind the flywheel, consists of fourteen coils of one-eighth-inch copper tubing.



World's smallest iceless refrigerator, 8 inches high, has a 3-inch flywheel. A half ounce of gas in tiny coils freezes water in the trays

Queer Rivers That Fail in Attempts to Reach Sea

QUEER rivers that never reach the sea, dotting the "Great Basin" of the West, have just been studied extensively by the Department of the Interior. They flow to inland lakes where the water vanishes by evaporation, leaving its dissolved minerals behind. Several thousand square miles of lakes are scattered through the basin, which extends west from Utah to include California and Oregon.

Largest of these lakes is Great Salt Lake of Utah—shallow remnant of the huge prehistoric Lake Bonneville. At another American "Dead Sea"—Searles Lake, Calif.—are great potash beds.

Abroad, the Dead Sea of Palestine, most famous inland body of water, contains more than forty billion tons of valuable mineral salts.

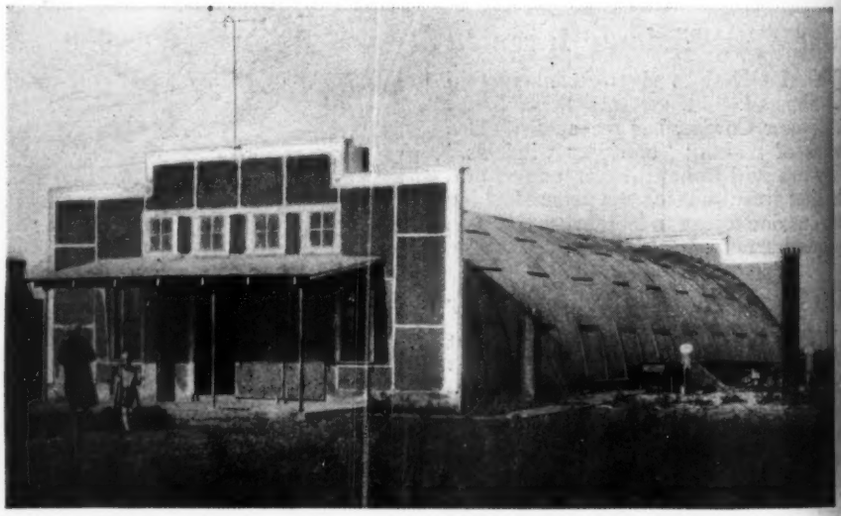
X-Ray Catalogues Minerals

TWELVE-INCH X-ray photographs of crushed samples of every known mineral are to be the basis of an identification laboratory for geologists, first of its kind, at the University of Wisconsin. Already 170 specimens have been "finger-printed" by the X-ray to identify duplicates without complicated analysis.

Oil Tanks Made into Houses

RUSTED oil storage tanks, no longer fit for use, have recently been found valuable, when split in halves by acetylene torches, as houses for power pumping stations.

One such power house, near Eldorado, Kans., was constructed of several sections of tanks, mounted on a concrete base, and closed at the ends. The house, illustrated below, shelters a fifty-horsepower pumping engine that operates a dozen oil wells. The exhaust pipe is to the right of the front. An underground tank through which exhaust gases pass on the way out permits them immediate freedom—a use for abandoned oil containers of smaller size.



Sections of oil storage tanks, on a concrete base, form this power house, in which oil pumping engines work at Eldorado, Kans. They form roof and sides; only front and rear walls have to be built. A smaller tank in the ground is an expansion chamber for gas, which pipe in foreground releases

Aurora, 600 Miles in Air, Highest Ever Seen by Man

ONE of the highest things ever seen by man, a remarkable display of the aurora borealis, or northern lights, was recently observed by Dr. Carl Störmer, Norwegian expert, who has made a special study of auroras. This one occurred at least three hundred miles above the earth, and parts of it may have been as high as six hundred miles. These streamers ascended far enough to take on a rosy glow from the rays of the sun, already set.

From a study of auroras, experts are able to tell something about the height of the atmosphere that girdles the earth. This latest one seems to show it may extend six hundred miles. So thin, the air must be here, however, that its pressure is less than a billionth of that at sea level.

Broadway Glare's 49 Rivals

NEW YORK'S "white way," Broadway, is by no means the only one, according to a recent survey directed by W. D'Arcy Ryan, director of the General Electric Company's illuminating engineering laboratory. More than fifty streets in America are brilliantly enough lighted by electricity to be classed as "intensive white ways." The investigators drew the line scientifically, placing the standard at 300 lumens (equivalent to light given off by a twenty-four-candle-power lamp) for every foot of the street.

How Not to Clean Dress

ELECTRICITY and gasoline did a thorough job of clothes cleaning recently in a house on the Teakwood Dairy Farms, near Bakersfield, Calif., occupied by an employee of A. B. Tieck, owner of the farms. The photograph below shows what was left of clothing and house after the "cleaning."

Static electricity, generated by rubbing of the garments, exploded the gasoline, and three women in the house were severely burned.

Silent but graphic testimony that gasoline is not safe for cleaning clothing. Friction in rubbing clothes in gasoline generated a spark of electricity which exploded the fluid and destroyed a house near Bakersfield, Calif., the remnants of which are seen here. Three women were severely burned

Three Boats Battered to Bits Filming the Colorado Rapids

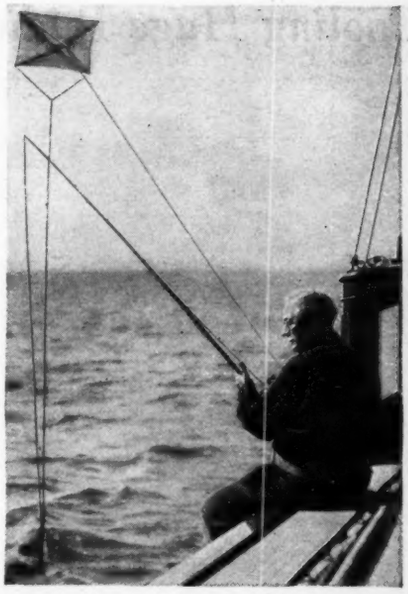
FIRST motion pictures of the treacherous Colorado River as it swirls through the Grand Canyon were recently brought back by an expedition headed by C. L. Eddy and Frank M. Blackwell, camera man. Twelve college students completed the party.

Three days from the start, Blackwell's boat was hurled against a boulder in the dangerous river rapids and smashed to kindling; the photographer continued cranking until knocked unconscious. Camera, film and operator were rescued. Before they reached the end of their unprecedented three weeks' chute of four hundred and ninety rapids, they had lost two more boats and all their food, and saved the valuable films alone.

A Bomber's Balloon Tires

THESE huge balloon cord tires, as big around as a man's body, take the punishment when the Army's latest bombing plane, the giant "super-cyclops," comes to earth. Their enormous size, as shown below, enables them to withstand a sudden shock of many tons.

Gigantic balloon tires of the "super-cyclops," newest and biggest U. S. Army bomber plane



He Goes Fishing with a Kite

WHEN James W. Jump, millionaire sportsman, goes fishing at Catalina Island, Calif., he takes his kite along! From it is hung, by a long line, a flying fish bait that skims the water in lifelike manner, causing swordfish to rise and seize it. Another line to the pole reels them in.

Year Breaks Health Record

NINETEEN twenty-seven has been a record health year, according to a great insurance company. Fewer persons among the company's policy holders died during the year's first half than in any corresponding period previously recorded. The nearest approach to this health mark was made in 1921.

Measuring between Atoms

EVEN the distance between the layers of atoms in a piece of metal can be measured by a new form of X-ray machine used in metallurgy, Dr. W. P. Davey, of the General Electric Company's research laboratories, recently told the American Chemical Society. With the new device it is possible speedily to predict the properties of untried metal alloys, saving years of actual test.

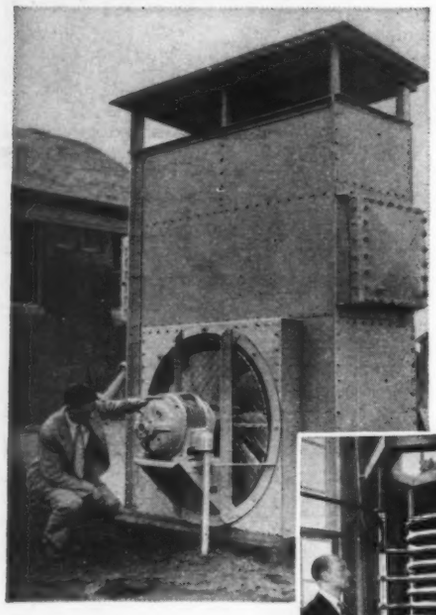
"Vest Pocket" Balloon Trip

IN A balloon which, when deflated, he could pack on his back, A. Leo Stevens recently made a 350-mile overnight flight to the Adirondacks from Englewood, N. J. So narrow were his quarters that he had to stand erect. Near Lake Clear Junction Stevens released 4000 cubic feet of gas, folded the balloon and boarded a train for Saranac Lake, N. Y.

What Do You Want to Know?

POPULAR SCIENCE MONTHLY is pleased to answer reasonable inquiries on subjects in its field. Send stamped, self-addressed envelope to Information Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

Cooling Huge Radio Transmission Tubes

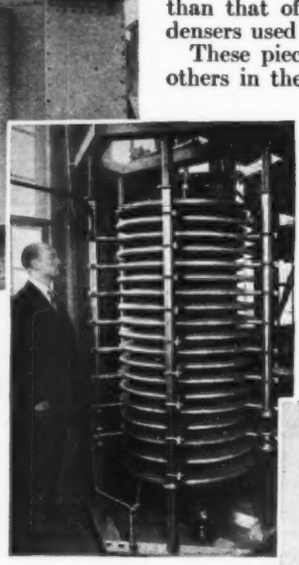


The powerful blower fan in WEAF's radio transmission station at Bellmore, N. Y., cools 4,000 gallons of water hourly

FOUR thousand gallons of water are cooled each hour to keep down the temperature of the giant tubes at radio station WEAF's new fifty-kilowatt transmitting station in Bellmore, N. Y. The great water cooler is equipped with a huge blower fan that chills the circulating water much as does an automobile's radiator.

Another striking feature of the new radio station is a set of huge fixed condensers. Though each stands higher than a man, its actual capacity is no more than that of the tiny, inch-square condensers used in small radio receivers.

These pieces of equipment and many others in the Bellmore station, designed and perfected by some of the foremost radio engineers of America, make the station one of the most efficient of its kind in the world. Yet plans are already under way for improvement, and so rapidly is the science of radio advancing that the plant may be utterly changed within a short time.



Note the size of this fixed condenser of the Bellmore radio station compared with a man of average size who is shown standing beside it

Gas Made from Water By New Electric Cell

ECONOMIES in manufacture and transportation of gas are promised by a new high-pressure electric cell that manufactures it from ordinary water alone. It has long been known that when strong electric currents are passed through water, hydrogen and oxygen gas are produced at the electrodes. The new cell, invented by two German experimenters, is the first to produce the gases on a commercial scale at pressures up to a thousand atmospheres.

Recent experiments have shown this compressed gas suited to long distance transmission.

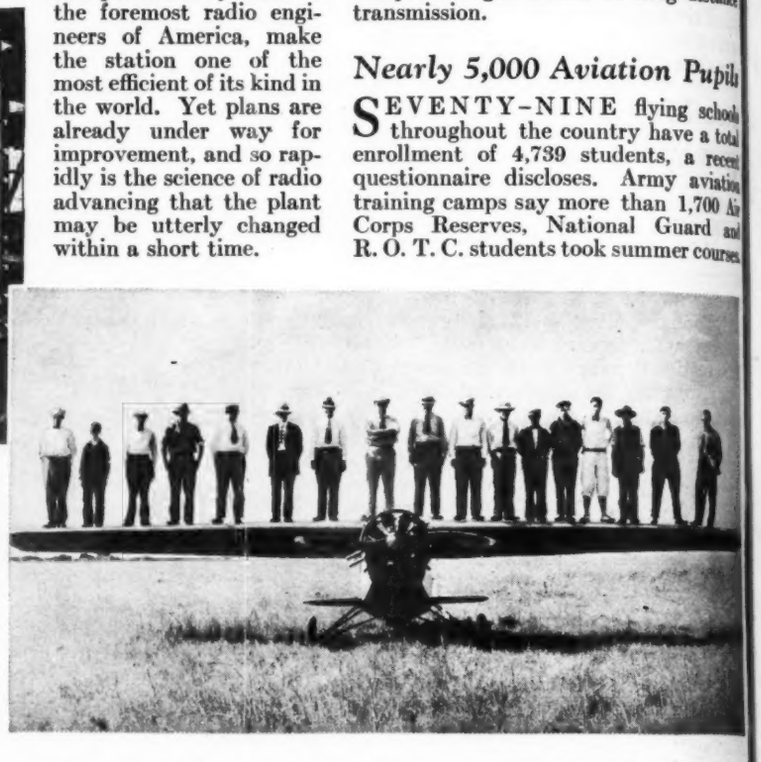
Nearly 5,000 Aviation Pupils

SEVENTY-NINE flying schools throughout the country have a total enrollment of 4,739 students, a recent questionnaire discloses. Army aviation training camps say more than 1,700 Air Corps Reserves, National Guard and R. O. T. C. students took summer courses.

Airdrome Afloat Near Completion

WITHIN the next six months, the U. S. S. *Lexington*, largest and highest powered naval vessel in the world, will be ready to put to sea, reports say. Shipbuilders are putting the final touches on the tremendous airplane carrier at Quincy, Mass., where she was launched two years ago.

Originally the *Lexington* was to have been a battle cruiser, but disarmament plans changed her to a mother ship for aircraft. She is 874 feet long, with the entire deck a flying surface. Elevators that hoist planes from storage in the hold stop flush with the cleared deck to make this possible. Steam-electric power includes electric motors developing 180,000 horsepower, giving a thirty-three-knot speed.



Although struts are dispensed with in the monoplane at the right, thus aiding speed, internal cantilever braces hold the wings so strongly that 17 men can stand on them, as shown

Monoplane's Unstrutted Wings Hold 17 Men

SEVENTEEN men recently stood on the wings of a new type of monoplane near New York City to demonstrate in a striking way its builder's claim that struts to brace them could be eliminated. This cuts down the wind resistance and consequently increases the plane's speed. According to its builder and pilot, C. V. Cessna, it can do 150 miles an hour. Internal cantilever braces keep the wings from sagging, even under such a severe and unusual test.

Earth Tides Likened to Sea's

BECAUSE it is by no means rigid, our earth's crust rises and falls like the ocean's tide under the gravitational attraction of the moon and sun. There is no doubt that this occurs, says Dr. Walter D. Lambert, of the U. S. Coast and Geodetic Survey, though difficulties have so far prevented exact measurement.

Another thing that makes the crust of the earth heave and fall, says Dr. Lambert, is the pressure exerted upon it in spots by the rising tide of the ocean. Atlantic tides have caused an observed earth bulge at Williams Bay, Wis., 800 miles away, and it is thought probable that this influence girdles the earth.

When Sea Gets Out of Gear

HUGE waves or swells that rise unexpectedly out of a calm sea, such as the one that recently rocked the liner *France* as it was about to enter New York harbor, are explained by G. W. Littlehales, Navy hydrographic engineer. Three different causes may produce such a wave, he said.

Most likely was the coincidence that several small waves, starting in as many distant storms, happened to meet crest to crest in a single spot. Again, a fast incoming tide may cause a "tide scar," or inclined wall of water at an inlet due to the friction of the bottom. And sometimes when masses of water of widely different temperature meet, a great swell or wave may be produced.

"Vacuum Bottle" Buildings

BUILDINGS and whole cities of glass are the amazing proposal of William Orr Ludlow, noted New York architect, going much farther with an idea noted in POPULAR SCIENCE MONTHLY for September.

"The use of glass," says Mr. Ludlow, "is the next logical step in the evolution of the window. There would be two shells of glass to a skyscraper, eighteen inches or so apart, leaving space to be made into at least a partial vacuum.

"I believe that it will be possible to heat and cool glass skyscrapers in the same way a vacuum bottle is used to maintain heat and cold."

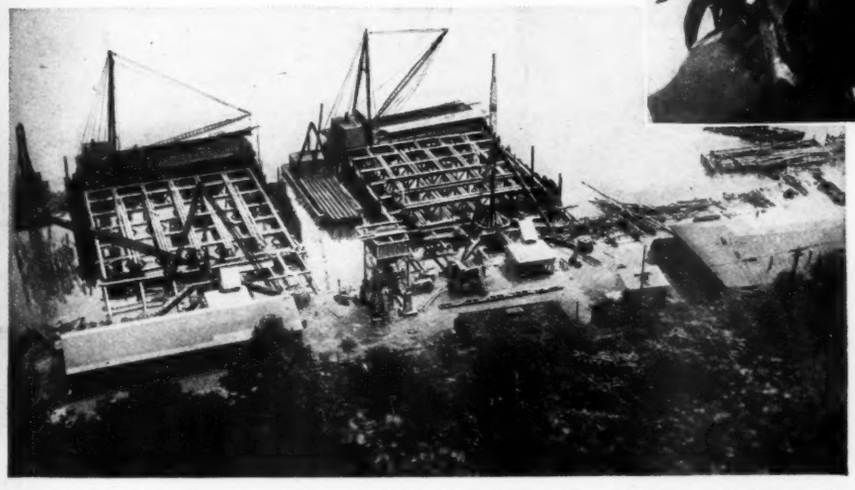
Good Airplanes Built In Many New Designs

IN WHAT direction is airplane design leading? "Scattering in all directions," says Col. V. E. Clark, chief engineer of a great airplane concern. There is no "standard" type of machine; never before have so many craft of utterly different structural and mechanical design been proving their worth.

"It would be most unfortunate for us to try to standardize at this time," says Col. Clark. "The longer one observes aviation the more one must realize what a tremendous amount is to be learned."

Bridging the Hudson at Last

AT LAST a mighty bridge is to span the Hudson River to connect New York City with the New Jersey shore. Amid the rattle of cranes and the puffing of steam engines, the foundations for the Jersey end of the great span are already being laid, as seen in the photograph below, beneath the shadow of the Palisades—the high cliffs that the finished highway will surmount.



An airplane view of the start of construction of the Hudson River bridge in the shadow of the Palisades. The picture shows the sinking on the Jersey side, across from 173rd Street, New York City, of the caissons in which will be built foundations for the massive piers. To form these bases for America's greatest bridge mighty cranes will pour countless tons of concrete

Race Horses with Glasses Run Faster, Tests Reveal

THE better a horse can see, the faster he can run—this was the theory recently applied by Dr. Ernest E. Emons, of Akron, O., to increase the speed of race horses. Tests that he made with special instruments and powerful lights made him sure that one horse out of every ten suffered from defective vision. Odd-shaped "specs" for racers were then tried out at Lexington, Ky.; and, it was said, the animals' time for a quarter mile was often bettered by as much as three seconds.

Although many circumstances vary a horse's speed, the average rate of animals in many tests with and without glasses convinced Doctor Emons he was right.

"Four Eyes" is not the name of this horse of the E. R. Bradley racing stable, but with his queer "specs" he reduced his time for the quarter mile nearly three seconds

Plant Punctures Tires

WAR continues against the "puncture weed," California's rapid-spreading vine whose half-inch thorns play havoc with motor car tires on country roads. The illustration shows L. S. Neville, chief county horticultural commissioner, with a single vine found near Los Angeles. It covered a circle fourteen feet across. Desperate efforts to check this troublesome plant's spread are hindered by its prolific seeds, 1,500 to a square foot, that mature all year round and force a continuous battle.

Census of Lightning Flashes

SOON amateur observers the world over may be asked to assist in a unique census of lightning flashes. At a recent meeting of the International and Geodetic Survey in Prague, Czecho-Slovakia, experts on atmospheric electricity urged that a careful count be kept in every country. An international agreement to organize the proposed study is expected. Only a few weather stations and isolated observers now report on the thousands of flashes estimated to occur each minute somewhere on the earth.

Though the total amount of energy set free by lightning is known to be enormous—far greater than all the power used by man—no complete figures are obtainable.

Battle Tanks Talk by Radio

PADDED headphones and ten-foot aluminum tubing aerials that would lie down for low bridges recently made possible the first radio communication between war tanks in action. The apparatus was invented by Capt. K. E. Hartley, British Territorial officer.

Hitherto the roar of the tank motors and artillery made conversation among crews difficult. With the thirty-watt transmitters and seven-tube receivers to make delicate tuning unnecessary, two tanks six miles apart talked with each other and with a base twelve miles away.

Mystery of Blue Geese Is Solved by Science

WHEN the National Zoological Park at Washington, D. C., discovered that the eggs must be dampened before they could be hatched, zoologists had their first glimpse of baby "blue geese," winter inhabitants of the lower Mississippi Valley. For this distinguished feat, the park has just received the silver medal of the Societe Nationale d'Acclimatation, French association to promote the artificial migration of plants and animals.

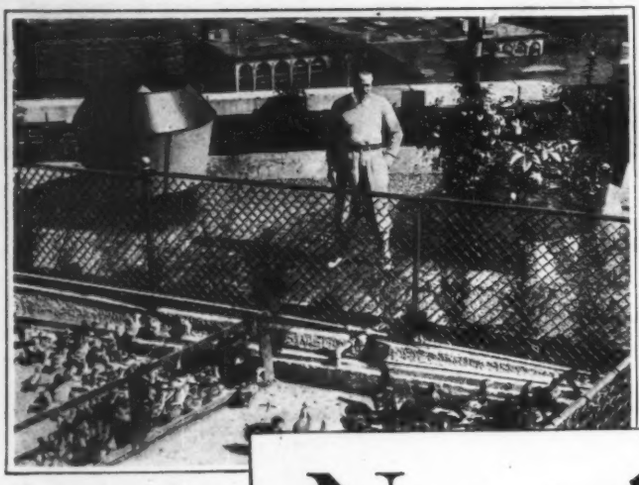
Eggs had been obtained before, from captive pairs, but never hatched.

Amphibian Commuting Planes

NOW a new type of amphibian plane especially designed for the commuter is being built by a Farmingdale, N. Y., concern. Folding wings enable it to be sheltered in a boathouse sixteen feet wide. It has a speed of 120 miles an hour and a cruising range of 600 miles. Shielding devices, it is said, offer such protection from the wind that a passenger may light a cigarette as easily as in a smoking car.

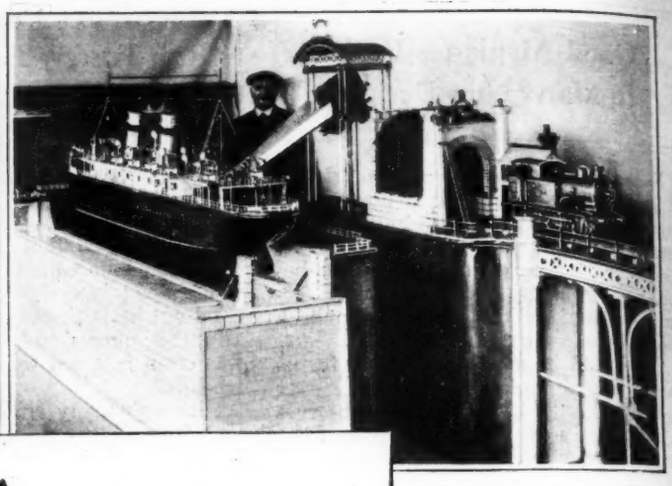
Flies Go Six Miles a Day

"TIME flies; you cannot—they go too fast," was a time-honored catch phrase, until recently the U. S. Bureau of Entomology did that very thing. House flies, it found, often made a journey of five or six miles in twenty-four hours. Some 234,000 flies of different species were obtained for the unique flight tests, which were conducted in Texas.



A Housetop Farm

On the roof of the Biltmore Hotel, Providence, R. I., L. Duane Wallick, hotel man's son, raises chickens, vegetables and flowers 400 feet above the street. Here he is shown after he caught a rabbit stealing his beans



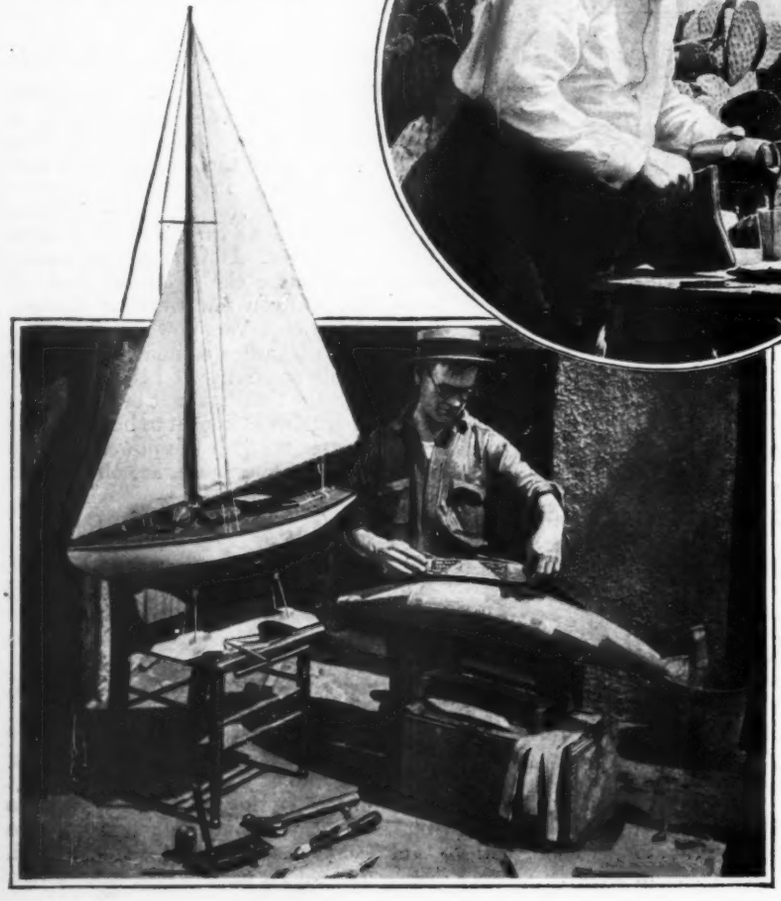
Smallest Colliery

Forty years it has taken Tom Thomas of Wales to build the miniature colliery, shown with him here. His work, noted eight years ago in this magazine, was finished recently. The steamship took six years to build

Novel Activities and Products of Original People

Ships Molded from Paper

Axal Bisguard, Brooklyn ship's carpenter, pictured below, pastes strips of newspaper, layer after layer, on wooden ship hull frames. The stout paper shells serve as the hulls for miniature ship models



Rubber from Cactus Juice

Dr. John C. Wichmann, Los Angeles, is shown at the left with the juice he extracts from cactuses by boiling, which he declares makes a satisfactory rubber substitute. He predicts that his method will soon turn cactuses into automobile tires

Chrysanthemums a Foot in Width

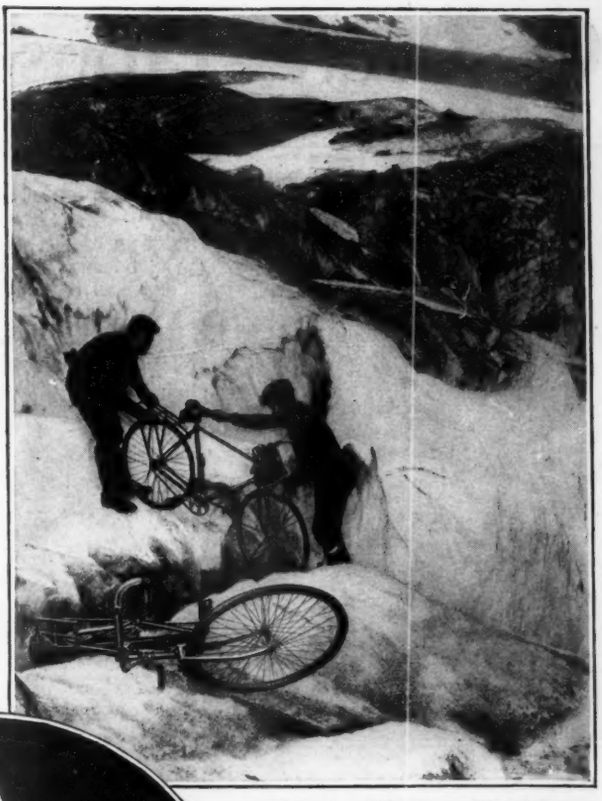
Thirty-five years' study and toil by E. W. Burghard, Colorado Springs, Colo., produced chrysanthemums which won the national championship. On eight-foot stems, they are nearly a foot wide

The Greatest Woman Cabinetmaker

Mrs. May Gilbert, seen below in her Oakland, Calif., shop, produces rare art works in wood and directs and besides instructs a corps of men and women assistants

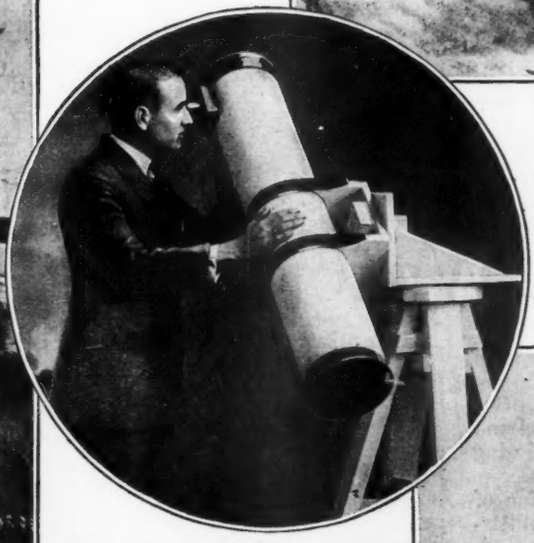
Seaplane Kings

These able Navy men recently set a seaplane record for endurance and speed, 1,568 miles in 20 hours, 46 minutes. Left to right, H. C. Rodd, Homer Vincent and Byron Connell



Bicycle Glacier Climbing

Equal to climbing the Alps on wheels was the recent feat of Russell Ridley, left, and Lawrence Steele, of Milwaukee, who on a transcontinental tour climbed Mount Rainier on bicycles. In negotiating the treacherous surface of the Nisqually Glacier they had to dismount as shown and climb with their machines across the yawning crevasses

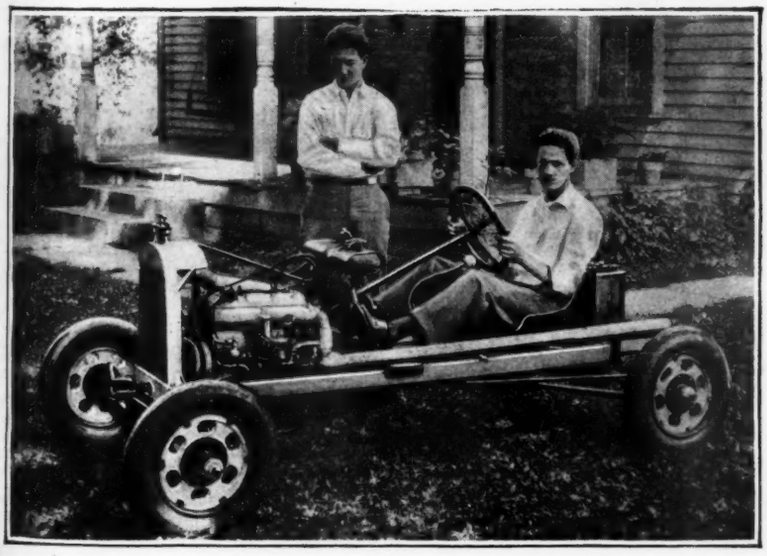


Telescope of Plate Glass

Gilbert Lueninghoener, Fremont, Nebr., built his own telescope, grinding the ninety-power reflector from plate glass

Propeller Serves as Airplane Brake

The motor and wheels on the center of this airplane propeller vary the pitch of the blades at the flyer's will, says J. E. Carroll, inventor, photographed with the device. When the pitch is reversed, he declares, the propeller will act as a brake, landing the airplane in twice its length



Aluminum-Wheeled Car Built in Spare Time

Frank A. Doll, standing, and Edward B. Doll, of Marshall, Ill., are seen at the left with the unique motor car they built in spare time in a year. Many of the parts they cast themselves and made of the raw material, such as the wheels, which are cast aluminum

Concrete House While You Wait

In building the house the T-shaped concrete "planks" are set on end. The tops form the outer walls. Into the bases of the T's are molded wood strips to which lath is nailed. "Planks" are light, but strong. A 20-foot one weighs 480 pounds

SOON America may have homes built while you wait. Engineers gathered at Manhasset, N. Y., the other day, witnessed a demonstration of housebuilding with new concrete "boards." Workmen raised these novel pieces of "lumber" into place and fastened them with steel wires to form walls and flooring said to possess the permanence of brick at even less than the cost of a frame dwelling.

Each of the long T-shaped planks—and they run two stories high—replaces 420 bricks and can be set in place in fifteen minutes.

A finished concrete board house at Malba, N. Y., which was erected in a few hours. The work is simplicity itself. Grooves are made in the foundation, into which the concrete boards are fitted, and then wired together

In the March, 1927, issue of POPULAR SCIENCE MONTHLY the concrete and steel houses of European experimenters were described. In this country Herbert S. Stoneham, of New York City, and Joseph Winston, engineer, sought with the cooperation of Columbia University laboratories to develop a concrete structural material flexible, yet strong; permanent and as good-looking as brick. From elaborate tests the new "plank" of concrete came.

Concrete is mixed by a formula developed in the testing laboratories. This is reinforced by wire mesh and steel rods embedded in the concrete.

Why Hot Water Pipes Freeze First

HOT water pipes freeze quicker than the cold. Householders who are well broken in know that. But why? The pipes are usually parallel and one would think heat could resist freezing temperature better than cold.

The first laboratory demonstration of this fact, made recently at East Pittsburgh by Leon McCulloch, research engineer of the Westinghouse Electric and Manufacturing Company, has now given a scientific explanation of this seeming violation of natural laws.

Having a possible explanation, McCulloch set up laboratory apparatus and after two weeks' intermittent work convinced himself and other workers that his theory was correct.

His new explanation is based upon the well-known fact that water is densest or heaviest a few degrees above freezing. On either side of this temperature, thirty-nine degrees Fahrenheit, water is lighter. For example, at forty-four degrees one quart of water weighs 945 grams and at thirty-nine degrees, 946 grams, while one quart of ice weighs only 887 grams.

A statement by McCulloch concerning his experimenting follows:

"This small change in density is enough to set up a circulation when the lighter thirty-two-degree water is at the bottom of a vessel and the heavier thirty-nine-degree water is at the top.

"Suppose we take a closed pipe filled with water and cool the lower end very slowly. When the water falls below

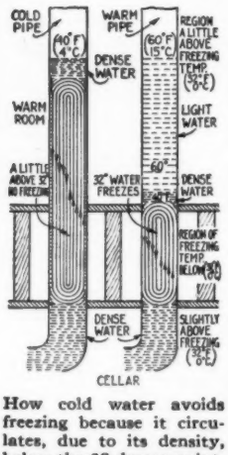
The laboratory apparatus that proves why hot water in a tube freezes sooner than cold, and Leon McCulloch, research engineer who made the experiment. He cooled water in one tube, kept it warm in the other and proved that the cooler liquid circulated the more

thirty-nine degrees it becomes lighter than the water at thirty-nine degrees above it. The colder but lighter water rises. Thus a circulation is set up. This circulation, however, does not extend all the way up, but takes place only below that point where the water is densest, which is where the temperature is about thirty-nine degrees.

"Above this point the water remains warmer, and, since it is lighter than the colder water below, it takes no part in the circulation.

"The amount of water kept in circulation depends upon the height of the thirty-nine-degree point above the place of freezing temperature.

"In the cold pipe it will be much greater than in the warm pipe. The circulation in both pipes tends to keep the water at the bottom from freezing, since the coldest water rises and the warmer water falls. Since there is more water in circulation in the cold pipe, it is more difficult to freeze that pipe than the warmer one.



How cold water avoids freezing because it circulates, due to its density, below the 39-degree point, and warm water freezes in the pipe because its lightness limits its circulation

"The actual water pipes in a house are not closed at the lower end, of course, but the conditions may amount to the same thing. There is often a horizontal stretch, along a cold ceiling, for example, just before the pipes pass a freezing cold space through a floor into a slightly warm room above."

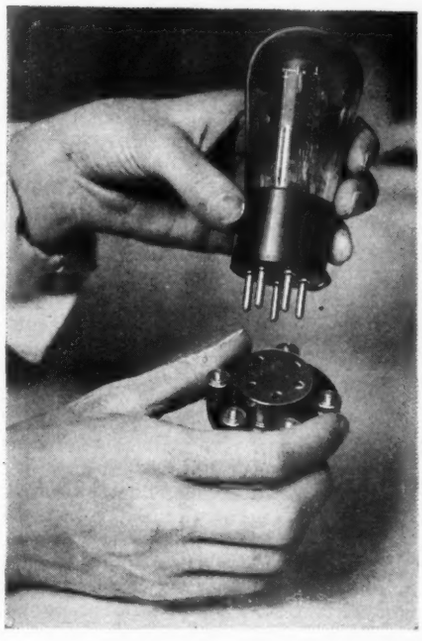
Useful Tips for Radio Enthusiasts

New Socket for A. C. Tubes

What Limits Distance?—Reviving Failing Batteries

SEVERAL forms of alternating current tubes are on the market that are operated by means of a heater element that is electrically insulated from the surface which actually emits electrons. A tube of this type must necessarily have at least five terminals—two for the current to operate the heater element, one to the surface that sends out the electrons, taking the place in the radio circuit of the usual filament connection in the radio circuit; another for the grid and the remaining one for the plate connection.

Some manufacturers have solved the problem by using the conventional four-prong base and socket in which case one of the filament terminals is not used, and they have added two terminals for the heater element at the top of the tube itself. This arrangement is excellent if you want to rewire an old set for alternating current operation, but if you are building a complete new receiver a neater job can be done with the alternating current heater type tube, shown in the illustration, and the use of the special five-prong socket that is specially adapted to it.



The new 227 type tube has five prongs on the base. It is designed for use on alternating current and requires a five-contact socket

Emergency Battery Measures

RADIO receivers operated completely by dry cell batteries often are preferred by people who are away from home a considerable portion of the time and who consequently use their receivers only at infrequent intervals. If you go away from home for a month or two you don't have to worry about a dry-cell-operated receiver. The batteries will, of course, age somewhat while you are away, but you don't have a storage battery to send to a service station to make sure that it will be in good condition when you get back.

However, a receiver that depends on dry cells to supply the A-current is subject to one annoying trouble. The dry cell A-battery usually becomes exhausted and stops supplying sufficient current right in the middle of the program. When the music begins to weaken, you turn the rheostat a bit and the music comes back to full strength. Then it begins to die out again and soon you have the rheostat full on. After that all you can do is to sit there and listen to the fading music or fight report until it disappears.

There is one emergency measure you can take to get you through the desired program. In most cases the A-current is supplied by a number of dry cells connected in series parallel. With three-volt tubes such as the 199, six cells are connected in two series of three each and the two rows are in parallel.

When you are satisfied that you can't get any more operation out of the batteries arranged in this way, disconnect one set of three and connect one of the group in series with the three cells of the other group, first making sure that the rheostat has been turned back at least halfway. The extra voltage may operate the set for as much as an hour before the voltage again drops too low to properly heat the filaments of the tube.

How to Build Your Own Electric Radio Receiver

EXPERIMENTAL work has been going on in POPULAR SCIENCE MONTHLY'S laboratory for some time in connection with the development of plans and specifications for a fully electrified radio receiver suitable for amateur construction.

Problems still remain to be solved, for we do not wish to recommend the construction of any type of receiver operating without batteries until we are positive that it will be easy to build and completely satisfactory in operation.

If you are interested in this particular problem, watch for important radio constructional articles which will appear in the near future in the columns of our Home Workshop Department.

Balancing Condensers

ASIDE from material and workmanship, which are, of course, important, the electrical measurements of any type of variable condenser are the points that determine its adaptability to any particular usage. Electrically speaking, a variable condenser has only two measurements. They are the maximum and minimum capacity. If the particular capacity you desire at any given point in a radio circuit is within the limits of a given condenser, you can use it successfully regardless of its size, design or the number of plates.

You couldn't use an ordinary tuning condenser as a balancing condenser, merely because the amount of capacity needed to balance the circuit would be below the low limit of the tuning condenser. And you couldn't use the average balancing condenser for tuning a coil to the various broadcast wave lengths, for exactly the opposite reason. The maximum capacity of the balancing condenser would be far too small to effect the desired result.

What Limits Your Distance?

WHILE good tone quality combined with adequate selectivity is the ideal most sought after in radio receivers sold today, and the craze for distance reception has died out to a very large extent, there still is a large demand for sets capable of bringing in distant stations. This demand comes from radio listeners situated in parts of the country where there are no local stations, or if there are local stations their programs are not worth tuning-in.

If you are in such a locality you must have a set capable of bringing in distant stations or else go without adequate radio entertainment. But no matter how much you are prepared to pay for a radio outfit that will do what you want, there are certain limits beyond which it is impossible to go even if you are a millionaire.

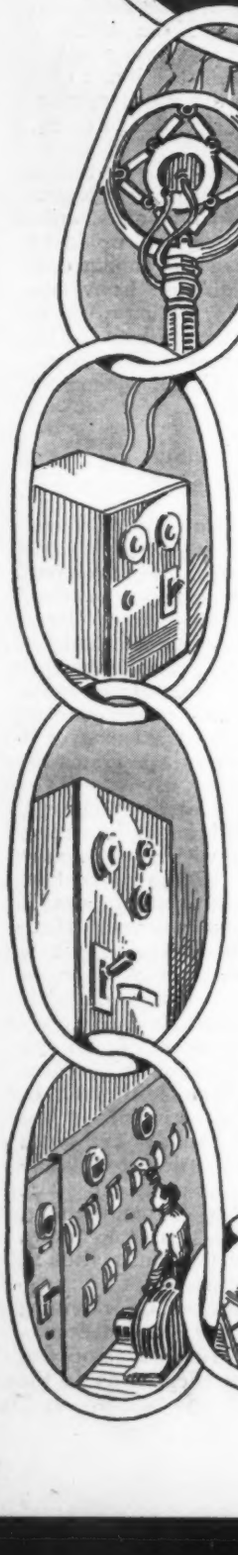
The limiting factor in all distance reception is static. No one has found any way to eliminate or even reduce the effect of static to any appreciable degree. In distance reception the strength of the signal in your locality will, at any given moment, have a certain definite relation to the amount of static. If the static level happens to be higher than the level of the signal strength, there is no known way of bringing in the distant station so that it will be worth listening to.

Increasing the power of the receiving set does not help in the slightest degree, because the static always is amplified to exactly the same degree as is the signal.

Why Can't I Obtain Tone Quality?

How You Can Tell Whether Queer Music Is Fault of Broadcasting or Your Own Set—Ways to Locate and End Trouble

By ALFRED P. LANE



In this series of links are shown the various steps that make up the chain of operations needed to bring the sounds made in the studio to your ears at home

The first step is the production of the music in the studio. This is picked up by the microphone which transforms the sounds into electrical vibrations

The next three links show the steps by which the tiny electrical impulses are magnified and transformed again into radio waves

These waves radiated from the antenna travel through space to your receiving antenna and the intervening link shows interference and fading between the two

OF ALL the thousands of radio questions we receive from readers of POPULAR SCIENCE MONTHLY, the most frequent is: "Why can't I get good tone quality?" And questions about the most elusive and easily destroyed quality of any radio installation are the hardest to answer because tone quality depends on so many things. Like a chain that is only as strong as its weakest link, tone quality may break down because of weakness in any of the numerous links between the broadcast studio and your home.

Of course you can't do anything about the links that precede the arrival of the signal at your own antenna, but an understanding of what troubles may occur in those outside links may save you efforts to improve your own equipment when the trouble actually is in the broadcasting station's installation.

If, for example, tone quality seems below par some evening, it will be worth while to know with certainty that your receiver is not at fault.

All sounds, whether of a violin, a bass drum, a truck running over cobblestones or anything else, are vibrations in the air. The only differences are in the number, arrangement and relative intensity of the waves of vibrations that reach your ear. It is quite difficult to produce a sound made up entirely of vibrations at one frequency. A tuning fork under ideal conditions comes pretty close.

Your ear distinguishes the musical instruments and human voices by the relative strength of these faster vibrations, called overtones. If some overtones are lost or suppressed, you either fail to recognize the type of instrument or the tone quality seems queer and not lifelike. Of course, the more sensitive your ear and the more you have studied music the better you can appreciate true reproduction. The object of all broadcasting engineers is to convey exactly the vibrations produced in the studio, but a weakness may develop in any link of the broadcast chain.

In an orchestra in the broadcast studio each instrument is producing its own particular vibrations, which are materially affected by size, shape, hangings and furniture. Formerly it was believed that all the sound that did not reach the microphone direct should be absorbed by padding on the studio walls. It was found, however, that the resultant music was lifeless because it was not natural, so studios now are designed to allow a little more of the effect you get on hearing an orchestra in a large hall.

If the microphone, heart of the broadcast system, fails to pick up any particular tone frequency and turn it into equivalent electrical impulses, distortion is sure to result. From the microphone the electrical equivalent is sent to the speech amplifier and here the impulses are built up to far greater volume. By careful adjustment carried on continuously during broadcasting, slight deficiencies in the microphone may be compensated. Carelessness of the monitor, as he is called, will spoil the tone quality.

BY THE next link, the modulator, the electrical impulses are further amplified and arranged in a form suitable for impressing on the carrier wave produced by the transmitter, which forms another link. Over-modulation and under modulation produce distortion, so this step has to be constantly watched.

The transmitter pumps electrical oscillations into the antenna, where they are radiated into space. About the only chance for distortion at this link is the possible effect of near-by steel work in absorbing part of the energy of the sidebands of the wave or in reradiation that will produce similar trouble. However, this matter is gone into thoroughly dur-

ing the preliminary testing of the station, so it is not likely to crop up unless additional buildings are erected in the neighborhood.

Once the broadcast energy is radiated into space, the engineers have no further control of it nor power over your troubles.

Fading is one of these troubles. It is produced, the experts say, by two branches of the same wave being "out of step" because one has traveled farther or met greater resistance. Then, too, a radio wave that travels a great distance becomes attenuated, and the loss is mainly in the side bands that carry the higher tones of music or speech.

YOUR own antenna is the next link. So far as tone quality is concerned, practically nothing can happen to affect it. Of course, if the antenna is too low or too short or the insulation is bad you will get weak signals, but the tone will be right.

Once the signal reaches your receiver, all sorts of troubles may cause distortion. With the average five-tube set, the first two tubes amplify the signal at radio frequencies. The amplification itself cannot cause trouble, but the tubes may be working under such poor conditions that there is a strong tendency to oscillation, or they may actually be oscillating all the time when the set is in operation. Neutrodynes that are not properly neutralized, coils that couple together, run down B-batteries or some other disarrangement may cause this trouble and the tone quality suffers because the signal is distorted.

After the signal is amplified by the radio-frequency amplifier tubes it is fed into the detector—the next link. Here other forms of distortion may creep in. The tube may be overloaded in an attempt to get more volume. The grid leak may be of the wrong value. The plate voltage may be too high or too low.

THE detector tube rectifies the wave and passes on the frequencies within the audible range to the first stage of audio amplification. Here the quality of the audio transformer is most important. It should amplify all audio tones evenly and to the same extent. If it does and the tube is in good condition and is working with correct B and C voltages, the signal will pass amplified but otherwise practically unchanged to the last audio stage of the power amplifier. Of course, the audio transformer that operates the second stage in your set or the similar unit in the power amplifier must be capable of amplifying uniformly, and the power tube must be in good condition and supplied with correct B and C voltages.

Tone quality is not dependent on the size of your power tube. You can get perfect tone quality out of the ordinary 201A tube used in the last audio stage, but hardly enough volume to be properly heard in a small room. All the power tubes do is to boost the volume and keep the tone quality right. You can't do that with the 201A tube, for the minute you try for volume worth listening to distortion creeps in, because the tube is overloaded. If you want volume with perfect tone quality you must use a power tube.

Naturally the loudspeaker is a most important link. It takes the electrical impulses fed into it by the audio amplifier or power amplifier and converts them into air vibrations that you can hear. It has no tone of its own and it can be accounted as perfect only if it reproduces accurately the electrical impulses in the form of sound waves without adding or subtracting anything on its own account. The terms "mellow," "beautiful tone," and so on, are meaningless as applied to loudspeakers.

Some distortion may be introduced after the sounds are transmitted to the air in your home. The shape of the room, the hangings on the walls and the position of the loudspeaker are important. If you get the wrong combination some delicate overtones may be lost or an echo effect may spoil the music.

The reception of the sound waves by your ears completes the chain.

If tone quality seems bad when you are receiving from one station, tune-in some other stations. Good tone quality on several of them will be a pretty sure indication that your equipment is not to blame. But when all the stations sound wrong, you may be sure that your own equipment is at fault.

Discovering the source of the distortion in your apparatus can best be done by a process of elimination. Since detector tube distortion is not likely to be severe as compared with troubles in the radio-frequency or audio-frequency end of the set, tune-in the nearest broadcast station and try cutting out the radio-frequency and audio-frequency stages, one at a time, until you locate the trouble. If the local station is powerful you can cut out the entire radio-frequency amplifier system by winding a coil of about ten turns, taking the radio-frequency tubes out of the sockets, connecting the ends of the coil you have wound to the antenna and ground wires and holding the coil near the detector tuning coil. If the tone quality under such conditions is much better, find out what is causing the trouble in the radio amplifier stages.

Connecting headphones in place of the first audio transformer will tell you if there is anything wrong with the audio amplifier, because the audio end should give as good tone quality as you ordinarily hear on the headphones from the detector.

Determining whether the loudspeaker is good is not so easy. Trying several speakers is about the only method possible for the amateur radio fan. This may take time and effort but that is also true of many worth while things.

Distortion that will spoil accurate tone reproduction may be produced in any of the radio links shown on this page

While the signal is still in the electrical form it may be distorted in the radio-frequency amplifier, in the detector or in the audio amplifier

The loudspeaker itself may not accurately convert the electrical impulses into sound waves and the location or hangings in the room may also cause some trouble

A neat and effective scissors sharpener can be kept on the sewing table without getting in the way. It is provided with a guide that is adjustable so the blades can be run over the stone at an effective angle

A new brush for renovating your furs has "bristles" made of "silk wire" set at an angle, amounting to a series of combs. These gently and gradually penetrate into hair and remove dirt quickly and effectively

New Household Utilities

Here is an end to the troubles of trying to read the paper at breakfast by propping it up with a salt cellar that falls over. The easel rack with its clips holds the folded sheets securely and turning them over is not difficult. The device is completely made of metal which is nicely finished and is therefore as ornamental as it is useful

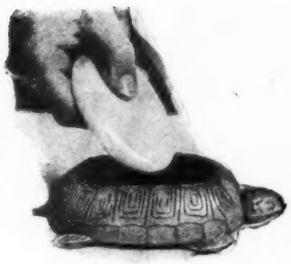
A Western woman is the inventor of the pie crust mixer shown at the right, which is designed somewhat on the principle of an egg beater. When the handle is turned the blades swing back and forth past each other. Unusual results in lightness of the crust are claimed. The sharp edge of the instrument also trims the crust

Keeping garbage out of reach of flies and also out of sight—an aesthetic advantage—are the purposes of this sink strainer. In emptying it you fold the hinged cover under to catch drippings

There is a floor lamp that has a shade on a swivel and so enables you to tilt its rays just where you wish them. For reading or sewing it is specially valuable. It gives maximum illumination yet protects the person using it and others from the normal glare

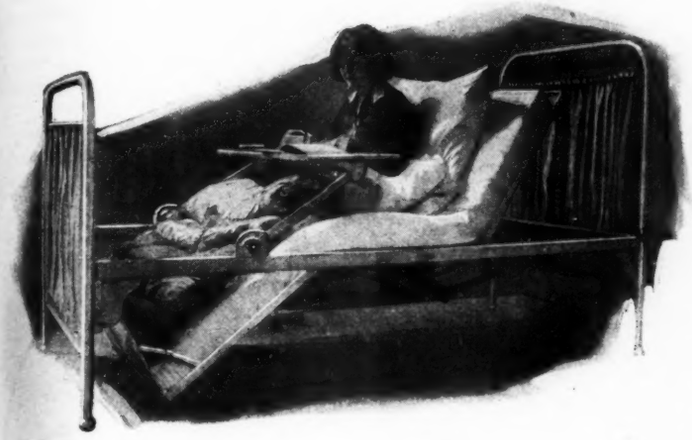
In these days of varicolored hosiery for women the little thread case below serves a great need. It carries compactly threads of all the shades for use whenever you mend hose

To keep burglars from coming in and children from falling out the window metal stops are attached to upper and lower sashes to limit the distance the window opens. When the stops meet they engage each other and the sashes will move no farther

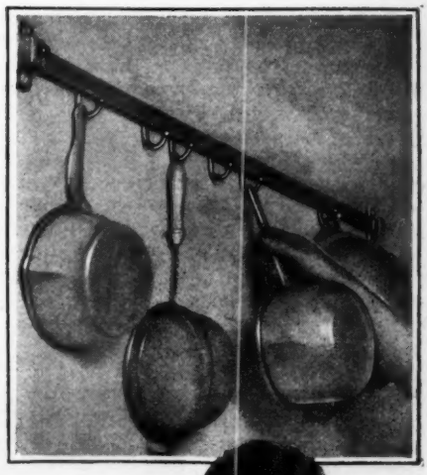


You will not have to search around the bottom of the bathtub for lost soap when you use this rubber container that floats safely and retains the cake securely no matter how much you splash. The unique device comes in all colors so you may select what goes best with the regular bathroom decorations

Here is a can opener that is said to make cut fingers an impossibility. The hard metal point sinks into the edge of the can, then ratchetlike teeth pull it around and the cover, a perfect disk, is lifted out, leaving no sharp edges on the container



Here is a novel bed invented in Germany for invalids and persons who don't like to get up for breakfast. It is somewhat like a barber or beauty parlor chair. The bottom bends down and the top up. A table moves with the mechanism, so that it is always conveniently near you

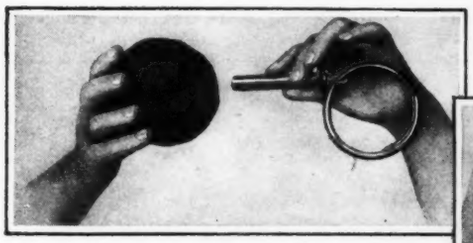


Here is a clever device for saving space in the kitchen. The rail is equipped with hooks for pots and pans that slide to any position, so small articles can go close together. When you wish to remove it the loosening of thumb screws at the ends makes that process very simple. It is put back just as easily

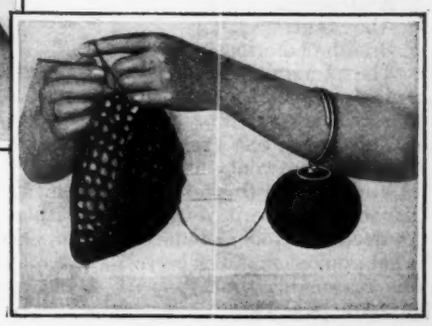
No more candles dropping out of the sticks or falling out of plumb. Soft rubber sockets fit into the sticks and around the ends of the candles, holding them in their place quite firmly

This steamer and boiler has a double bottom that is easily cleaned and also makes it possible to cook things without danger of burning. Set one way, it keeps food above water and turned the other it lets them boil

Here is a metal guard that slips over the latch before you close the door. After it is closed another guard slides down and holds it in place, so no burglar's jimmy can operate on the latch. It has also a hole that enables you to lock it on a closet door of a hotel room, thus guarding your property against theft when traveling



To darn or knit without losing or tangling your yarn you may use this bracelet which has a small metal rod attached. Stick the rod through the ball and slip the bracelet on your wrist. Then your material is always where you want it and yet it is never in the way and if you forget or misplace it you need not have to chase it all over the floor in order to regain it



Mental Handsprings with Sam Loyd

Give Your Wits a Workout

Six Puzzles to Test Resources of Your Brain

PUZZLES that have more than an amusement value, because they train the mind to think fast and straight, are presented on this page each month by Sam Loyd, the world's foremost puzzle maker. They show conclusively that a puzzle can be fun without being nonsense. See how quickly you can answer the problems given. Then turn to page 141 to find the correct answers and the time allowed for obtaining them, and see if your mental machinery is in trim.

Alphabetical Arithmetic

THE letters of a certain word were numbered consecutively—1, 2, 3, 4, 5, 6, 7, 8, 9 and 0. Then a two-column sum was arranged wherein the ten digits were each represented once, and the correct total set down.

R	I
P	T
D	E
N	S
C	A
I	P N

In our sketch the thirteen figures in that sum and total have been translated into the ten letters of our word in keeping with their assigned numerical value.

Now we are required to substitute figures for the letters. It is a test of one's ingenuity in word construction rather than an arithmetical exercise. If you work out the answer, which you can find by turning to page 141, in the time allowed you will show rare aptitude.

Finding a Hidden Science

IN THEIR given order write down words to fit the following definitions:

Toss.
Leave one country to settle in another.
Battle.
A larder.

Now if the line is composed of the correct words, you can strike out of them words to fit the following definitions:

A cavity in the ground.
A fireplace.
Abundant.
Breathe laboriously.

The remaining letters, in the regular order, will spell the name of an important science.

This test of one's readiness with words may call for twenty minutes' time.

You will find this no easy problem, but if you can solve it you can congratulate yourself on your alertness of mind. See what you can do. The correct answer and the reasonable time to work it out are given on page 141.

Kindergarten Finance

KITTY said to Harry: "Give me one of your pennies and I can buy an apple for baby and one for myself, and you will have just enough money left to buy one for yourself."

"No," replied Harry, "baby has no teeth and could not eat an apple. You give me one of your pennies and then you and I can each buy an orange and baby can watch us eat them."

How many pennies did the children have?

This little exercise in mental arithmetic should not require a great deal of your time. Turn to page 141 for the correct answer and the time allowed for solving.

A Roman Mob

AN OLD-TIME stage manager was telling of his ingenious method of producing a Roman mob scene by marching a handful of supernumeraries around the back "drop."

"How many were in the circle?" we inquired. "I don't recall exactly," he replied, "but I was in the procession, and four fifths of those ahead of me added to one quarter of those behind me equaled our total number."

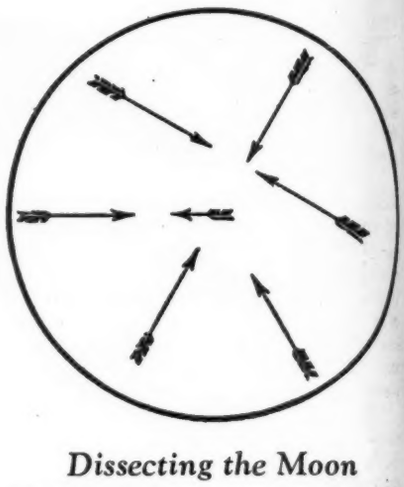
From his statement we are to figure out how many men constituted that Roman mob.

Try your mathematical perspicacity on this, then see on page 141 the correct answer and the time allowed to find it.

A Puzzling Criss Cross

IT IS required to draw three straight lines across the circle pictured below, so as to produce seven separate inclosures, each inclosure containing one arrow.

To mentally corral those seven arrows with a three-fence construction calls for sharp vision and accurate judgment with respect to distance, angles and alignment. See if you can find the solution as given on page 141 in the time allotment shown there.



Dissecting the Moon

WE ALL know now that the moon isn't really made of green cheese, and anyone who thought such a thing would be quite properly laughed at, but for the sake of a problem let us suppose that it is and that it is really crescent-shaped as it appears in the picture. Into how many pieces can that crescent cheese be cut by four straight slashes with a knife?

We are asked to draw four straight lines across the rectangle, the lines being criss crossed in such a manner as to produce the maximum possible number of segments within the crescent. Any four lines would produce a considerable number of pieces, but the problem demands the four lines that produce the greatest possible number. Here is a hard test of your abilities. To find the correct solution and the time you should require to reach it turn to page 141.

Sam Loyd has prepared another set of his fascinating new test puzzles which will appear in next month's issue of POPULAR SCIENCE MONTHLY.

Build for Your Wife, But—

Don't Let Her Waste Money and Destroy Beauty by Changing Your House Plans During Construction

By JOHN R. McMAHON

"HOW much is our house going to cost, George?" asked his little wife one evening.

"Exactly seven thousand, five hundred dollars," replied the young man, looking up from a sheet of paper crowded with penciled figures. "And that figure includes everything down to a toothbrush holder in the bathroom."

"You have a wonderful head for arithmetic, dear," said Dora admiringly. "Some day you may become Director of the Budget—you know, at Washington—and save the Government lots of money."

"I don't claim to be a wizard." George expanded his chest a trifle and gave her an indulgent smile. "The main thing in keeping down the cost of building is to figure everything out to a dot and then don't change plans. That's us."

"Oh, George, that reminds me! I saw that model house up on the hill today and we simply must change our plans a teeny bit. That house has a better looking entrance than ours and it has the cutest, most convenient near-hall between the living room and kitchen."

Expensive alterations in plans after house building is under way may be avoided by making cardboard models which show the home as it will appear. These are particularly helpful to those who cannot "read" blueprints. Models such as that in this picture are built at from $35 to $350 by experts in the art

"We agreed not to change," grumbled the young husband. "Still, I don't like our entrance myself, and since we haven't actually begun to build, I guess that cut-rate architect wouldn't charge much to fix up the blueprints."

THE name of the cut-rate architect was Delancey Jones, and he truthfully claimed descent from a line of robber barons. Why, he had the nerve to charge $50 for the change in design while saying that this was a nominal fee without profit. He argued that $4 an hour was the lowest legitimate rate for an architect's service and he was only charging $3.50 plus cost of linen, paper and sundries. George and Delancey had quite a discussion about cut rates, inheritance from robber barons and the density of home owners who think that brain work expended on a dwelling is a total loss. The net result was that George revised the estimated cost of his house to $7,550.

"Anyhow, we're through with Delancey," said the young man, "and the builder won't try to gouge us. He is a plain chap with an honest name, Wilbur Smith. He has about as much use for architects as I have. He says more than half the houses in America are built without any architects around and don't they look it? That is, they're just as good as the other kind. A regular builder doesn't bother much with plans. He is like a good piano player who just sits down and plays anything you want by ear. Of course Wilbur can figure, and he is just now figuring out just how much extra those changes are going to cost."

Wilbur presented an amended bid which raised the total for the house to $7,678.43.

"Oh, what a lot of extra money!" exclaimed Dora. "And do you think that forty-three cents looks natural, George?"

"That," glumly stated the husband, "shows close figuring. All the big corporations make their financial reports down to a few cents. Wilbur is honest. But this is positively our last change. The work starts tomorrow and I want to serve notice on you, Dora—"

"Perhaps I'll serve notice on you, George," sweetly rejoined the young woman.

It happened that Dora was right. George decided to alter the location of the built-in garage after the cellar walls of concrete had been poured. About fifteen feet of wall had to be demolished and rebuilt, not to mention consequent changes above. It was really a worth while improvement and the broken up concrete was not all wasted, George said, because it came in handy for fire-stopping. Wilbur was reasonable. The cost of the house was increased to $7,782.69.

AFTER this there were quite a few minor and a couple of major alterations. Wilbur said he couldn't find time to bill all the extras as they occurred but would keep track of them and put in a fair charge at the end.

Dora received some gift furniture from relatives, mahogany and walnut. In order to make it fit in the house one partition and two windows had to be shifted. It would have been cheaper to buy new furniture but the gift pieces were handsome and also had a sentimental value. The open fireplace and mantel had to be changed to harmonize with a scheme of decoration recommended by an artist. The kitchen required alteration so that a new style electric refrigerator would fit in an alcove. A side porch was extended by several feet. Venetian window blinds, bought and paid for, did not look well in place and were thrown in the discard.

When the young couple moved into their house its cost had risen over a thousand dollars above the original estimate and stood at $8,596.32. Wilbur had all the extras neatly itemized. He had done the

Building Queries Answered

READERS should feel free to ask the advice of Mr. McMahon in any problems they may encounter in building homes and to ask further information concerning any subjects or details discussed in his articles. Letters should be addressed to John R. McMahon, Housebuilding Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

best he could, charging so little that he almost lost money on the whole job.

George and Dora typify many thousands of home makers in America. Shall we laugh at their comic errors or sympathize with them in their misfortune? Shall we use this case as a text for a rousing sermon on the use of an architect in the planning of your home, and the advantages of foresight in building?

Much to the surprise of the average reader and myself, who are equally inclined to lecture and uplift, an eminent authority says that it is futile to seek a moral in the tale of George and Dora. They went wrong, but so did Adam and Eve, and so will the majority of home builders as long as the world lasts. In truth, it is human nature to change plans and make mistakes.

Listen to Ernest Flagg, nationally known architect of the Singer Building and creator of the Flagg small house:

"There is no argument as to the great waste and loss involved in changing plans, especially after construction of a building has started," he told me. "What can be done about it? Practically nothing. It has always happened and always will. There is indeed one way out of it, which forms a rare exception to the general rule. That is when a client accepts his architect's design, then goes away and comes back only when the house is finished. The client does not visit the site, sees nothing and knows nothing of the building process.

"This was the method followed by Charles Scribner, the publisher—the most intelligent man I ever met—when he commissioned me to do his house. He saw the house for the first time on the day when it was completed and he was moving into it. And he was entirely satisfied."

Photographs furnished and copyrighted by The Architects' Small House Service Bureau of the United States, Inc.

These pictures show how changes decided on during construction can alter an architect's original conception of a house. The upper picture is an architect's drawing of a pretty and well designed, though not elaborate, home. Below is a photograph of the house built from the architect's plans. Why does the one look so much more attractive than the other? In the first place, the blinds were omitted. More important, the building was perched on too high a foundation. Most important, the extra dormer built between the original ones destroys the symmetry of the structure

"SUPPOSE you were building a house for yourself, Mr. Flagg?" I asked.

"I would do like everybody else," was the frank reply. The noted architect smiled a little, toying with a paper knife as he sat in the high-ceilinged and sparingly decorated consultation room of his New York office. "I would find plenty of things that I'd want different as the job progressed."

"More study of plans in advance has been offered as a remedy," I suggested.

"That sounds reasonable to some persons, but it is not effective. More understanding of plans by clients simply intensifies the trouble. The more they know the better they grasp the possibilities of change."

"Does the architect as well as the client lose by changes?"

"Yes, very often. I am undertaking a job for a New York hospital and the numerous shifts from the original design have already eaten up all my fees in advance. I might charge for this extra service, but do not like to do so. Nobody in particular seems to be responsible."

"You do not approve mere fickleness on the part of home builders?"

"No. There is one kind of changing that is entirely inexcusable. That is when a man has a good plan done by a competent architect and he listens to advice on modifying it by any Tom, Dick or Harry who comes along. Something like this happened to one of my small houses in New England, a case where I did not supervise execution and the owner was receptive to miscellaneous advice. Afterward he wrote me that the alterations from the original plan had been a great mistake."

"Do contractors take advantage of people's weakness for plan changing and charge unfairly for 'extras'?" I asked.

"Many of them certainly do," replied Mr. Flagg. "There is protection against such gouging on large or expensive dwellings where the architect puts a unit cost clause in the specifications. This is what I do, and when a change is wanted I do not ask the contractor what the price will be, but tell him what he may charge on the unit cost basis. But this protective measure involves expensive figuring and is never found in the ordinary small contract."

According to the associates of Alexander B. Trowbridge, who used to plan many dwellings in the metropolitan suburbs, the annoyance of continually revising finished designs, and even structures, was one of the reasons which impelled him to leave this field. Mr. Trowbridge is now a consulting architect, who does business largely with his fellow professionals. He is also architectural adviser to the Federal Reserve Bank system.

"Contractors on city cooperative apartments often take jobs at cost," I was told by G. Gallico of the staff of Andrew J. Thomas. "They figure that they will make enough profit on alterations desired by tenants—moving partitions, redecorating and whatnot. One woman tenant paid $4,000 for an apartment and spent as much again for changes. One of the biggest items of added expense is an extra bathroom at a point remote from the original plumbing system, which causes duplicate piping throughout. Incidentally, I believe the high cost of modern building is due largely to a demand for luxurious bathrooms, three of them in a house where one used to serve."

THE inability of most persons to read or understand plans is a leading factor in changes during construction, according to Carl F. Grieshaber, of Delano and Aldrich, which firm designed a house for John D. Rockefeller, Sr.

"Cannot plans be simplified for laymen?" I asked. "That is, by omitting the numerous lines and figures that are useful only to builders?"

"We do so in sketches which are preliminary to the working drawings," replied Mr. Grieshaber. "Sometimes we have models made so that the client can visualize the appearance of his house. It is rare that a model shows the interior. A fancy exterior model, say three feet long, costs around $350. It is usually built of cardboard with celluloid windows. A less expensive model, costing around $35, may be put together from the architect's sketches. A house embodies many complexities of line, proportion, color and setting, and a model tends to give us a clarified complete view of the enterprise. The architect often resorts to models of small details, such as a certain style of molding. He studies this sample or experimental section and decides whether to embody it in the final design."

"What about the cost of changing plans?"

"Architects (*Continued on page 163*)

"Your Car Need Never Freeze"

Gus Tells of the Best Mixtures to Use in the Radiator and Gives Tips on Winter Motoring

By MARTIN BUNN

"This ring tailed sizzling cuckoo is going to blow up any minute! Hurry up!" Joe rushed for the door, but his partner Gus stopped a second to grab a large fire extinguisher from the wall

"GOT plenty of alcohol in your radiator?" Joe Clark inquired of his customer as he cranked the gasoline pump in front of the Model Garage. "Pretty cold today—better let me test it, anyway."

"You keep away from that radiator," Tom Madden objected. "No more expensive alcohol for me! I've got a trick worth two of that. You won't see me wasting any more money on alcohol for any automobile radiator. And what I'm using won't boil away or evaporate like alcohol."

Gus Wilson, Joe's partner in the Model Garage, drove up in his car just in time to overhear Madden's statement.

"So you've worked out something real new," said the veteran auto mechanic. "How long have you been using it?"

"Nearly two weeks now," replied Madden. "It sure works fine. Maybe I'll tell you what it is some day if you're real good!" he called back as he drove off.

Joe was impressed. "Must be good if he can get by with it in this weather," he exclaimed. "It's been cold enough to freeze a brass monkey all this week. What do you suppose it is?"

"I don't suppose—I know—didn't I smell it?" Gus grunted. "He only thinks he's found something new. I'll bet he'll be singing out of the other side of his mouth before long!"

"BUT what is he using?" Joe asked as Gus opened the big garage doors.

"Humph!" growled Gus, "it's a good thing you aren't as dumb as you seem sometimes. You must have a cold if you couldn't smell what he had in the radiator."

It was two days later that Gus, at work on a car, and Joe, engaged on the books in the office, were startled by a tremendous clatter outside the garage followed by a flow of distinctly forceful language.

"Hey! Open your dod-gasted door and let me in, will you?" roared an impatient voice. "This ring-tailed sizzling cuckoo is going to blow up any minute! Hurry up!"

Joe rushed for the door, but Gus stopped a second to grab a large fire extinguisher from the wall.

"It's Madden back again," muttered Gus, and as Joe swung the door open Madden was dimly visible through a cloud of blue smoke that smelled overpoweringly of kerosene. Just then the motor gave a peculiar, squeaking grunt and stalled.

"That marvelous new antifreeze solution isn't so good after all, is it?" observed Gus with a sarcastic smile as he replaced the fire extinguisher, now that the motor had stopped and the danger of a fire was past.

"You said it," admitted Madden glumly. "Kerosene may be good for lamps, but it sure is punk as a radiator filler in place of water. Just look at this car! The upper hose connection busted and now the dinged stuff is all over the place. What made it work so rotten all of a sudden? It's worked fine up to now."

"You must have been doing some hill climbing," suggested Gus, and the other nodded in assent.

"KEROSENE is no good to cool a motor when it's really working hard," said Gus. "It doesn't carry away the heat as water does. Besides, kerosene rots rubber double quick—especially when it's hot. The boiling point of kerosene is way higher than is good for the ordinary auto motor. Kerosene is all right if you only drive slow for short trips. Lots of fellows use it if they only drive down to the station and back or to the factory where they work—sort of light taxi service, you might say."

"Doesn't it rot the hose connections when you use it like that?" Madden asked.

"Sure it does," replied Gus, "but if you put in new hose connections right at the beginning of winter and smear the inside of the hose with thick shellac and leave the radiator empty overnight so the shellac gets a chance to set, usually the hose connections will last out the winter.

"You want to remember not to use any radiator cover with kerosene in the radiator. All the cooling surface you've got is none too much, because the kerosene doesn't soak up the heat from the cylinders and carry it to the radiator more than about half as well as water."

"Don't worry!" interrupted Madden. "No more kerosene for me! Get busy and fix whatever made the motor stick and put in new hose connections. Then I'll be a good little boy and fill it up with alcohol as Joe suggested."

"Fixing the motor may be easier than you think," Gus said with a smile. He stepped in the car and the motor turned over and started at the first pressure on the starter pedal.

"Well I'll be blasted!" gasped Madden. "What did you do, hypnotize it, Gus?"

"I didn't have to," Gus answered as he shut off the motor and rummaged under the front seat for the starting crank. He turned the motor over several times to test the compression and then put the crank

(*Continued on page 137*)

Ingenious Kinks *for* Your Car

Exhaust Melts Windshield Ice — Water Pumps Tires — Secret Ignition Switch — Other Ideas

IN LOCALITIES where the water supply is delivered to your home at a pressure of fifty or sixty pounds you can arrange to let the water pressure do the work of pumping up your tires. All you need is an old water tank, the larger the better, and a few pieces of piping. Fig. 1 shows how the tank should be set up. Assuming that the tank is empty, when the water is allowed to flow in at the bottom from the supply pipe, the air in the tank is compressed until it equals the water pressure. If you attach the air hose to your tire valve, the compressed air flows into your tire as the water rises in the tank. The float valve is needed only to prevent water being forced into the tire when the air in the tank is all used up. To put the tank in condition for another series of pumpings shut the supply valve and open the drain cock. This allows the water to flow out of the tank and a fresh supply of air rushes in by way of the air hose. Since some pressure is required to overcome the valve spring, you cannot pump a tire up to a pressure exactly equivalent to the water pressure.

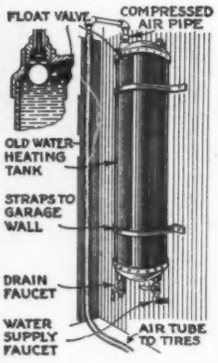


Fig. 1. You can use an old hot-water tank, piped as shown, to give you air pressure for pumping your tires

Ten Dollars for an Idea!

HAROLD NOWELL WHITMORE, of Oak Park, Ill., wins the $10 prize this month for his suggestion of a windshield ice-clearing device (Fig. 2). POPULAR SCIENCE MONTHLY awards $10 each month, in addition to regular space rates, to the reader sending in the best idea for motorists. Other contributions used are paid for at the usual rates.

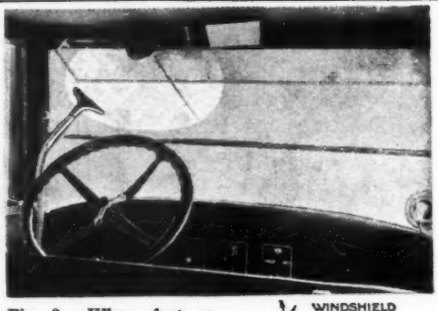


Fig. 2. When sleet or snow begins to stick you need a windshield heater to make driving safe. As shown in this illustration, the windshield is heated by hot air supplied by a special exhaust pipe stove and old vacuum cleaner parts

Fighting Snow on Windshields

NO WIPER will keep your windshield clear when snow freezes to everything it touches. Then you must apply heat to melt the snow. Fig. 2 shows a homemade hot air heater applied to the exhaust pipe. A funnel arrangement with the opening toward the fan forces air through the stove, up an old vacuum cleaner hose and out the nozzle, also a vacuum cleaner part. The air keeps the glass above the freezing point, enabling the wiper to work. Some experimenting will get the nozzle the right distance from the glass.

Cures Sagging Garage Doors

GARAGE doors, because they are large and heavy, often give trouble. They sag and stick and the pounding required to open them loosens up the hinges and aggravates the trouble. Fig. 3 shows a simple way to brace the door so that there will be less tendency to sag. Metal bars with a cross section measuring ¼ by 1 inch are bolted to each door as shown. Aside from stiffening the whole door, these bars transfer the weight to the point best able to bear it, the lower hinge. If the metal bars are not easily obtainable, nearly as good results can be got with boards.

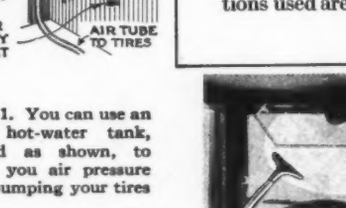


Fig. 3. Metal bar braces bolted to your garage doors, as shown, reinforce the doors and prevent their sagging

Novel Secret Switch

THE value of any secret ignition switch depends on how cleverly it is concealed. The switch shown in Fig. 4 is so constructed that it doesn't look like a switch and can be placed in plain sight if necessary. No one would suspect the wire cleat of harboring a concealed break in the wiring. The cleat can be cut from any piece of hard wood. Drill the holes for the two screws and carve a groove for each wire end from the center notch to the screw hole. Then enlarge the screw holes just enough so that small loops can be turned in the ends of the wires and placed in these holes. Use flathead wood screws with copper washers and figure out the size of the enlargement at the bottom of each hole so that when the screw is forced down tight, each wire end will be jammed between the side of the hole and the screw so as to get a good electrical contact. A piece of spring brass cut to snap under the edges of the flathead screws will complete the connection between the wire ends. Of course round-headed screws would ordinarily be used, but anyone noticing the flathead screws is most unlikely to attach particular significance to them. If you install this switch in an old car, dirty the cleat to make it look old.

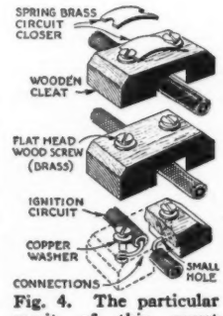


Fig. 4. The particular merit of this secret switch is that it need not be hidden from view. It does not look the part

Several convenient locations for the concealed switch will suggest themselves. Check up the location of the wire running from the timer to the dash switch and then choose the easiest location to get at.

Weatherstripping Your Garage

SECTIONS of old inner tubes tacked along the lower edge of the garage door will help keep the garage warm and prevent fine snow from being blown under the door. Be careful that the tube projects only far enough below the edge to make contact with the ground. If it hangs too far it may get caught and jam the door when it is closed. If the doors fit too loose at top and sides additional sections of inner tube can be nailed to the frame so that the doors will press against them when they are closed.

Doors thus made air-tight will keep the car clean longer after each washing, as they exclude dust.

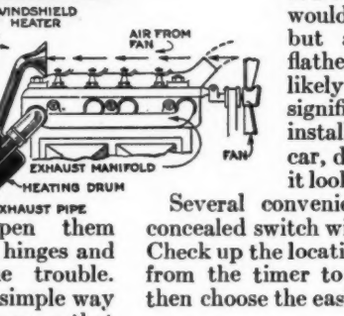


Fig. 5. How sections of old inner tubes weather-strip garage doors

New Bremer-Tully Products Command Attention

B-T Speaker Coupler. For tone quality and increased volume. Protects Speaker and prolongs its life.

B-T Audio Coupler. The Remedy for Harmonic Distortion. More than a Transformer—and better.

B-T "A" Transformer. Makes your Power-Six "Electric." For Light Socket operation.

Old Standards of Comparison Discarded

Bremer-Tully have just released a new product which they believe will create world-wide discussion.

It is the result of discarding the old idea of "Amplification Curves" generally used as a basis for comparison in audio transformers.

B-T have attacked this problem from an entirely new standpoint—that of "Harmonic Distortion."

B-T believes the Audio Coupler they have designed along these lines is a very wonderful advance in reproduction. Space does not allow full explanation here. It will be found, however, in the B-T Booklet, "Better Tuning." See coupon below.

The Audio Coupler is more than a Transformer. It is designed with constant impedance core, and a Tertiary loading coil. Those who know Bremer-Tully's standing appreciate that they could not release such product if they did not believe it superior.

There are two types. The 3-31 is for first stage. The 2-22 is for second stage, or for all three stages, where three stages are used. This is particularly useful in replacing three stage Resistance Coupled Amplifiers.

Bring your old set up-to-date by replacing ordinary transformers with new B-T Audio Couplers. Be sure to use them in your new set.

Price, either type $6.00.

The Speaker Coupler

Put a B-T Coupler between power tube and speaker and you will improve your reception wonderfully.

You will not only secure better tone but also get much greater volume, particularly on air column speakers.

You will protect your speaker also and prolong its life.

Note from illustration that various combinations enable you to use the one giving best matching between speaker and tube.

Fits inside cabinet or on table. No tools necessary. Price $7.50.

The A. C. Power-Six

The new "A" Transformer replaces storage batteries and enables you to run your Power-Six direct from the electric socket.

There is nothing later—or better.

Tell us just what your problem is when writing.

Price of "A" Transformer $7.50.

Price of Complete Diagram and Instructions for changing or building new A. C. Power-Six. $1.00.

"Better Tuning" is an 80-page booklet answering the latest questions in radio.

It tells about B-T sets. If you are also interested in parts please state same when writing.

Use Coupon.

520 S. CANAL BREMER-TULLY MFG. CO. CHICAGO ILL.

PIONEERS OF BETTER TUNING

Send 80-page "Better Tuning," 12th Edition to.....

.....

I am interested in factory-built.....

A.C. sets.....Speakers.....

B-Units.....Kit-Sets.

I am a dealer..... Consumer..... Set Builder.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Set No. 904
12 tools—oak cabinet
Price $15.00

The three most important Xmas questions

They are: (1) What gift gives the most lasting pleasure? (2) What gift offers most for the money? (3) What gift is offered at a range of prices that permits selection according to the amount you wish to spend?

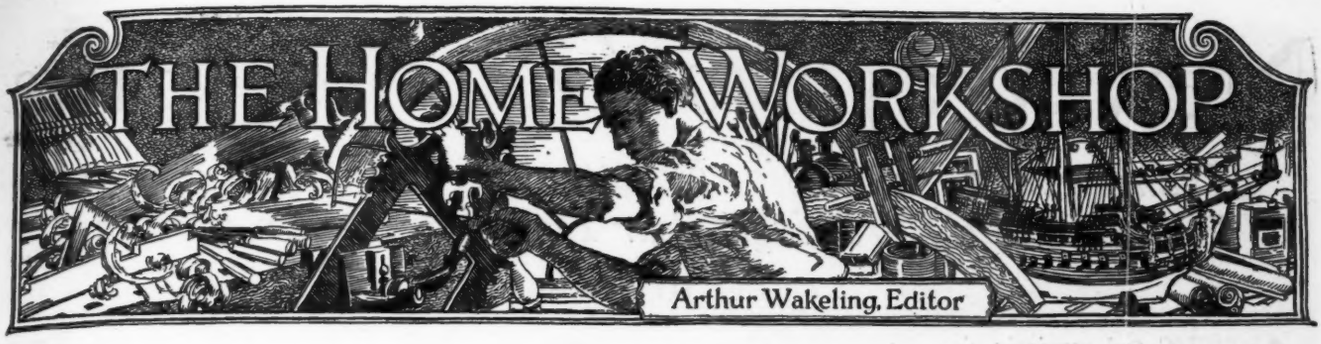
These three questions are answered by Stanley Tool Sets. Stanley Tools are known the country over as the most complete line of fine woodworking tools. Stanley Catalog Se35 shows 18 Tool Assortments costing from $5 to $95. Your hardware dealer has these sets or can easily get them. Ask him for Catalogs Se35 and Se50. If he cannot supply you write us for free copies. The Stanley Works, New Britain, Connecticut.

Set No. 907—7 tools in cardboard box—Price $5.00. This set includes plans for making a tool cabinet.

Set No. 902—20 tools—oak chest
Price $25.00

STANLEY TOOLS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



At Last—The True "Santa Maria"

How to Build a Simple but Valuable Model of the World's Most Famous Ship as She Really Looked

By E. ARMITAGE McCANN

MOST model makers would like to build a model of that famous ship, the *Santa Maria*, if they knew that the result of their efforts would be reasonably like the vessel in which Christopher Columbus sailed to America. With the aid of the accompanying plans, any handy man now, for the first time, can do this.

It can be safely asserted that none of the models of the *Santa Maria* seen here, there and everywhere are much like any vessel Columbus could have used. The best of them are a century out of date.

The "store models" are obviously not like any ship that ever floated. They are not ship models at all and, although one has no objection to them as decorations, to advertise them as authentic reproductions is false and misleading.

This beautiful and decorative model of Columbus' vessel is authentic in all of its essential details

The carefully fashioned models built to the plans of the full-sized replica of the *Santa Maria*, and sent to this country for the World's Columbian Exposition at Chicago in 1893, are another matter. They may be considered as good models of a seventeenth century carack.

It is perhaps venturesome to question a conviction that has existed for thirty-five years and to say that all the models that have been made from that vessel, including those in national museums such as the Smithsonian and South Kensington, are wrong, but in this the writer has the support of all the real experts who have studied the subject. They are agreed that she is much too fancy a vessel of the seventeenth century, instead of an old carack of the fifteenth.

Henry B. Culver, in his "Book of Old Ships," illustrated by Gordon Grant, says:

"It is unfortunate that the well-meaning Spanish gentleman who prepared the plans and designs for the Columbus fleet sent to the United States for the Chicago celebration of 1893 could not have had the benefit of the efforts of these English scientists. It is safe to say that if he had, the alleged replica of the *Santa Maria*, the principal result of his earnest if misdirected efforts, would not have borne the form she does—for she is still in existence, disseminating to this day

(*Continued on page 82*)

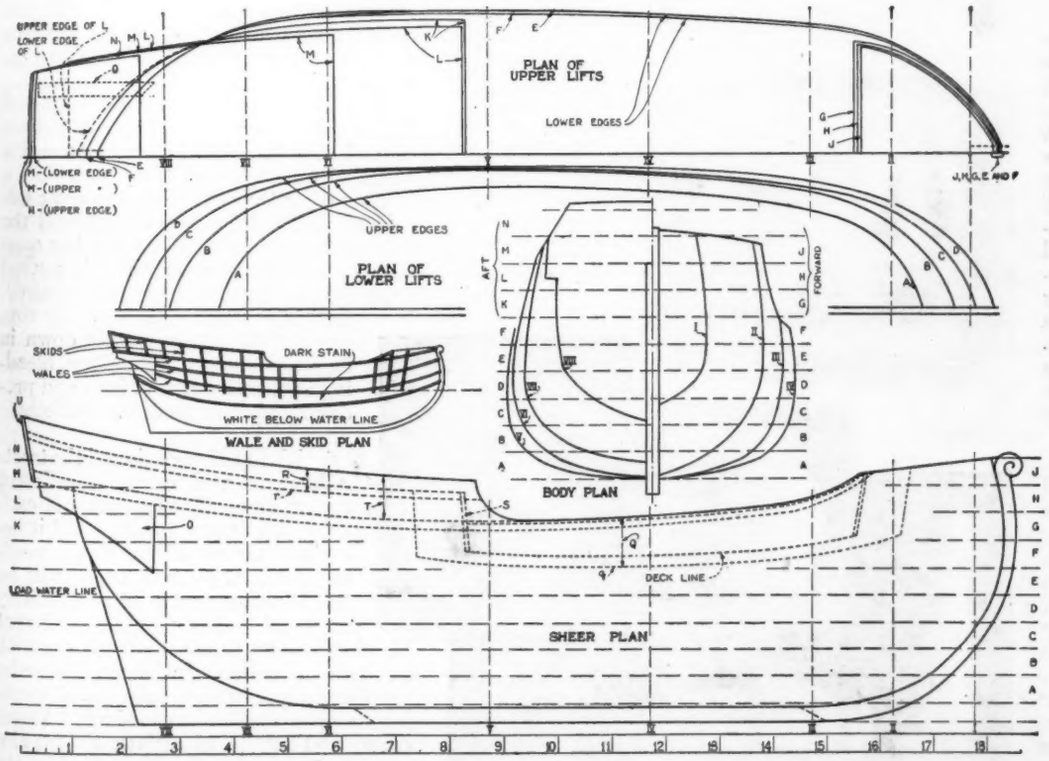


Fig. 1. Hull measurements, sheer and lift plans, and other important dimensions are clearly indicated

New Ways *to Decorate* Gifts

Transforming Inexpensive Novelties into Artistic Christmas Presents—Polychroming, "Pour Finishing," Other Methods

By BERTON ELLIOT

ARTISTIC and genuinely desirable Christmas gifts can be prepared at absurdly little expense if you know the secret. It is just this: Buy well designed but cheaply finished novelties and art wares, or else get entirely unfinished articles, and decorate them yourself by the easy methods which have been recently devised for amateurs.

All manner of things may be decorated. Vases, candlesticks, flower holders, bowls, book ends, plaques, boxes, door stops, salt and pepper sets, cake boards, wooden spoon and fork sets and the like may be found in ten-cent stores, variety shops and hardware and house furnishing stores. Woodenware, glass, pottery, china and metal articles may be purchased unfinished in artists' supply and department stores. And in every home there are already many objects waiting to be redecorated.

How a preserve jar or any inexpensive piece of pottery may be decorated by pouring lacquer over it

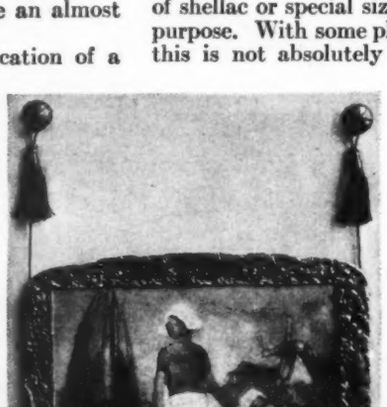
Following are a few methods which will enable you to undertake an almost unlimited range of work:

Polychroming is the application of a plastic composition, which is stippled into textured or relief effects and then colored, bronzed, and wiped off to produce a multicolored surface.

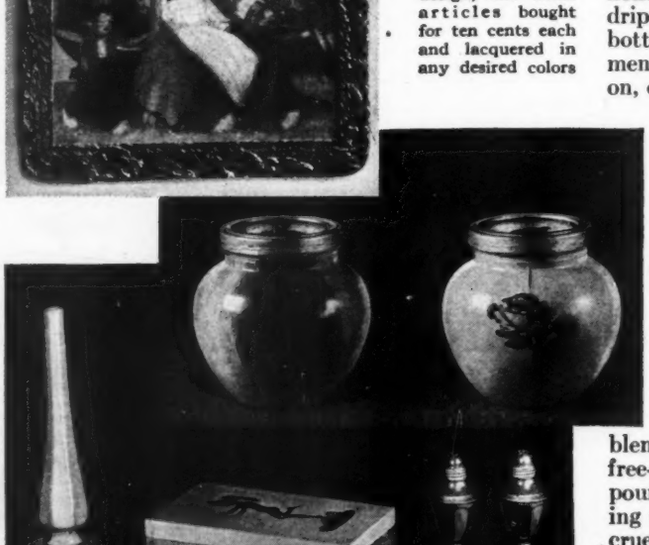
Various plastic materials are employed. Gesso clay or Italian clay, sold in small cans, is extensively used, as is plastic wall paint. A gesso preparation may be made by mixing together about ½ pt. whiting, ¼ pt. liquid glue, and 3 teaspoons each of varnish and linseed oil. The proportions may be varied slightly as necessary to produce a composition of good working consistency; it must be sufficiently stiff to stay put when modeled into relief effects.

THE material is brushed on to the surface or applied with a knife. After it has set for a few minutes, it is stippled in various ways. A brush, spoon, spatula or paring knife may be used to produce scrolls and fanciful designs. Confectioners' icing tools or pastry ornamenting tubes are sometimes used for more elaborate designs.

When thoroughly dry, the surface is usually given a sealing coat of shellac or special size adapted for that purpose. With some plastic compositions this is not absolutely necessary, but it is always a safe practice. It may then be given any color treatment desired.



WALL plaque made from a colored print, covered with cheesecloth and shellacked so that it resembles an oil painting. The frame is polychromed gesso. Below—"Pour-finished" preserve jars, one with a transfer design, and other articles bought for ten cents each and lacquered in any desired colors



A TYPICAL method is to give the surface a foundation coating of gold, silver, copper or green bronze, or a suitable tint of flat wall paint, enamel or lacquer, and then to use for the polychroming either oil colors, flat wall paint, glazing colors or the new brushing lacquers. The glazing colors are applied with a brush. Before they have commenced to set, they are wiped with a cloth from the high spots and other places, as may be desired. One or more colors may be applied and wiped off, followed when thoroughly dry with other colors handled in the same manner. One color peeps from beneath the edge of another, producing beautiful effects. Frequently the polychroming is done entirely with bronze powders—first a foundation brush coat of gold, silver or any desired shade, then a coating of Japan gold size, and a final "patting" on of bronze powders of other colors with a piece of velvet.

"Pour finishing" is one of the newest forms of treatment. Brushing lacquer seems to be especially adapted for this work, both as to working properties and appearance. The only supplies necessary are several cans of lacquer of different colors and a drip pan, which may be any pan, plate or other shallow receptacle.

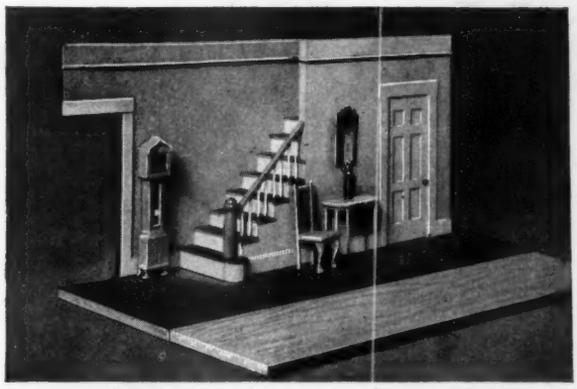
The object to be decorated is placed in the drip pan and one color of lacquer poured over it so that it runs down the sides. If the object is set up on a block a little smaller than its base, the color will drip off and not form a bead around the bottom edge. Before the color has commenced to dry, another color is poured on, or as many colors as may be desired, until the surface is entirely covered. The lacquer runs down in irregular streaks and stripes, blending in fanciful formations and producing the most exquisite effects.

A LITTLE variation of the treatment will cause a different appearance. For instance, if each color is allowed to dry until it becomes "tacky" before the succeeding color is poured, there will be less blending and a more definitely streaked effect. Still different blends may be produced by those with free-hand or china-painting experience by pouring on one or two colors and working up scrolls and other designs. Vases, cruets and bottles of artistic shapes also are sometimes decorated by pouring the lacquer into the (*Continued on page 126*)

A Christmas Doll's House

It Can Be Made at Small Cost by Any Handy Man or Boy—Complete with Furniture

By F. CLARKE HUGHES



How the stairs are built and the hall is furnished with a miniature clock, table, chair and mirror

NO CHRISTMAS gift is apt to delight a small girl quite so much as a really fine doll's house. To her it is a fairy home where her doll children can live and play. She can devise new furnishings, redecorate the rooms, and sweep, dust, wash and cook to her heart's content.

And after all, isn't that the secret of a satisfying toy? It must allow the child to do something genuinely constructive and stimulate her imagination and ingenuity; at the same time, it should convey a sense of grown-up reality. A doll's house does all this, especially if it is as complete and realistic a model of a house as the one illustrated on this page.

The house is a realistic scale model of a fine Colonial home

AT FIRST glance this doll house, based upon one of the most popular Colonial designs, may appear to be complicated in its construction, but when examined closely and studied well it will be found relatively simple for any handy man or boy to build in spare moments in his home workshop. Only household tools are needed and no high degree of skill or previous experience is called for.

To make the work still easier, two supplementary blueprints, each 15 by 22 in., have been prepared. These contain working drawings of both the house and its principal furnishings, many of the details being full size. All the drawings are much larger and more complete than it is possible to give in the limited space available in the magazine. The blueprints can be obtained by sending 50 cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY (see the list on page 102).

The first thing to do is to study the drawings until a clear understanding of the method of construction is obtained; the next is perhaps to examine the list of numbers and sizes of all the parts needed for the house as given on Blueprint No. 72, or, if the blueprints are not used, to compile such a list. It may be made from the drawings which are reproduced on pages 104, 106, 108 and 110.

The best material to use is either plywood or wallboard, because they do not readily warp or split. The thickness for all the major parts of the house should be preferably ½ in., although ⅜-in. stock can be used if the other cannot be obtained. Of course, any difference of thickness will make a slight variation in the length of some of the parts. As many of these materials come in regular sizes of ¼ in., they may be glued together and used double thickness to make ½ in.

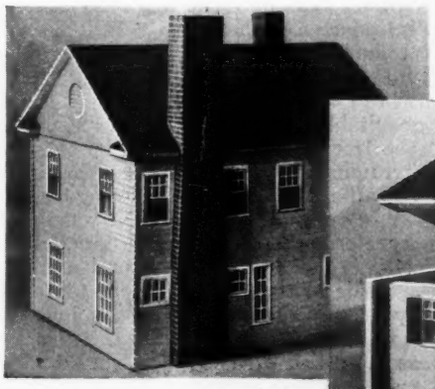
VENEERED stock such as is found in some packing boxes may be made use of in the construction of the house. This usually is ⅜ in. thick and may be had very cheaply.

The drawings accompanying this article and those on Blueprint No. 72 are for a house that is just one twelfth the size of a real house, and all of the furniture and parts are planned on this scale. A smaller house may be made by reducing the dimensions proportionately. To make this easy, a scale has been placed on Blueprint No. 72 for your convenience if you wish to build a house 21 by 25½ in. instead of 28 by 34, base measurements.

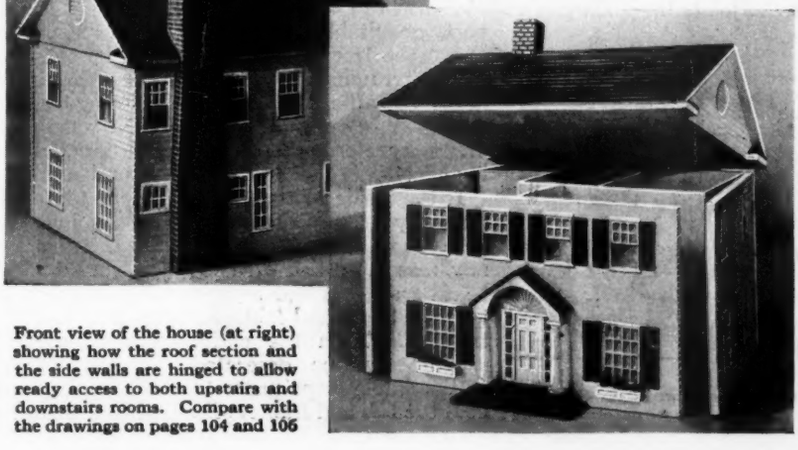
In Figs. 2 and 3 are shown the method of construction; the dimensioned parts are illustrated fully on Blueprint 72. With the two floor boards, Nos. 3 and 4, squared and sandpapered and the upper ceiling board No. 2 in shape, the position of the walls should be marked off carefully, using the plans in Fig. 1 as guide. Nos. 3 and 4 are each ½ by 27 by 33 in., while No. 2 is ½ by 29½ by 34 in. The main floor board is reinforced on the edges with a 1 by 2 in. strip marked 4A in Fig. 2; this extends all the way around the edge and across the middle.

As the second floor

(*Continued on page 104*)



At the left is a view of the house as seen from rear



Front view of the house (at right) showing how the roof section and the side walls are hinged to allow ready access to both upstairs and downstairs rooms. Compare with the drawings on pages 104 and 106

New Ways to *Light* Your *Tree*

How to Create Brilliant Christmas Effects—An Illuminated Stand, Varicolored Spotlight and Other Novelties

By LAWRENCE B. ROBBINS

DECORATING the Christmas tree is truly an art. With so many varieties of electric bulbs available in countless sizes, shapes and tints, you can create the most gorgeous effects, and play with light and color like a stage decorator. Only a little ingenuity is required. And even if you happen to live in an old house not regularly lighted by electricity, you can illuminate the Christmas tree with six-volt bulbs operated by one or two storage batteries hired for the purpose or even taken from an automobile.

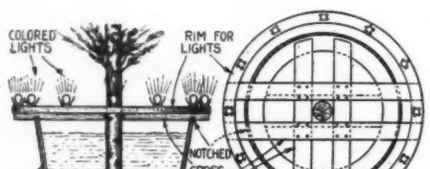
Magically beautiful effects are possible with simple homemade apparatus. Success depends upon the novelty of your scheme of decoration

Find some novel scheme of decoration. That's the secret of setting up a noteworthy tree in these days when all Christmas trees are so excellently ornamented.

For instance, look at Fig. 1. It is a tree stand with water to keep the tree green, combined with a unique, effective, yet inexpensive illuminating scheme.

The base is a common washtub. Use a fairly large one and make it water-tight. In the bottom fit a plank with a hole in the center to take the butt of the tree. Provide two narrow boards to go across the top edge of the tub on each side of the tree trunk. Cut notches in the underside of the boards to fit over the tub rim; then bolt two similar pieces to the underside of the first, at right angles to them, so as to leave a square opening in the center for the tree. The lower pieces should fit tightly inside the tub rim.

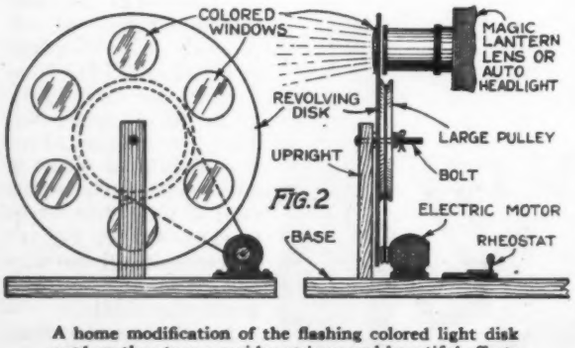
Get a stout wagon wheel rim, if possible, or build up a two-ply rim by sawing out segments of wood and nailing them together in such a way that the joints between two segments in the upper layer will come in the middle of a segment in the under layer. Place the rim over the extending ends of the two upper cross planks and bolt it in place. Then fasten electric light sockets around the rim about 6 in. apart as shown. Use different colored bulbs and introduce a flasher in the circuit, if one is to be had.



The tub base firmly supports the tree and the water helps to keep it green for a long time

Partly fill the tub with water, insert the tree and cover the tub with Christmas paper or suitable decorations. When the tree is decorated, the upstreaming, varicolored lights and the reflection in the water below will give an unusually colorful and charming effect.

If the inside of the tub is unsightly or it is desired to hide the water from view for any reason, a disk of cardboard may be fitted around the tree trunk and laid over the tub. Then the entire support can be decorated with suitable crepe paper to hold the tub and framework.



A home modification of the flashing colored light disk used on the stage provides unique and beautiful effects

Another effective novelty is to string the tree in the ordinary manner with varicolored bulbs intermingled with long streamers of tinsel. Place a small electric fan, pointing slightly down, at each side of the tree near the top. The conflicting breezes from the fans play among the tinsel streamers and keep them fluttering. This gives a surprising sense of animation to the tree, especially when a flasher is also used.

A charming color disk that will automatically play lights of various color upon the decorations of the tree is another means of making a striking display. Such a color disk can be made by any man handy with tools at small expense.

Cut out a disk of wallboard about 24 in. in diameter. Choose stock that is perfectly flat, and if there is any likelihood of its warping, nail the edge to a light wooden hoop of the same diameter. Next saw out a wooden pulley of ¾-in. stock and groove the edge. Drill out the exact center, place the wallboard disk over the pulley with the two centers coinciding and fasten them together with small nails. Then cut six round holes about 4 in. in diameter in the remaining face of the disk, spaced equidistantly. Cover each hole with a piece of celluloid, yellow, blue, red, and so on. Such celluloid often can be obtained from a large stationery house, but it can be prepared at home by coloring clear celluloid with aniline dyes.

Old ornaments can be fitted with bulbs to give mellow lighting

Now make a wooden base of considerable size, fasten an upright wood support near one end, and provide a ½-in. bolt at the top as shown in Fig. 2. This acts as a spindle on which disk and pulley turn. Place a thick washer on each side and insert a cotter pin through the bolt as a retainer. The disk and pulley should revolve easily without wabbling. Just below the pulley and at one side of the base, mount a small electric motor with a small pulley and belt it to the disk pulley with a round

(Continued on page 134)

The Gift—that will never wear out

—the grindstone-tested

Ingersoll

No longer need you "give until it hurts." Or worry about making an acceptable selection.

Thanks to Chas. H. Ingersoll, for many years manufacturer of famous popular priced watches, you can choose the most desired of gifts—high grade tested fountain pens—without embarrassment to your Christmas budget.

Now, you can handsomely remember several of your loved ones for less than you paid heretofore for a single pen of comparable size, color, beauty and wearability.

The outstanding distinction of all Ingersoll pens is the hard Iridium tip on solid 14 Karat gold nib—proved by the official grindstone test (described in last column of this page) to be good for unending wear and smooth writing.

Other Ingersoll features—unsurpassed in even the highest priced pens—include the simplest and most reliable of self-fillers; extra large ink capacity; clips that hold but don't wear the pocket and a lifetime guarantee.

All models are similar in construction and quality, differing only in sizes and styles of holder and sizes of gold points. And every Ingersoll is everlasting tipped with hard Iridium.

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Standard Nickel-Silver Barrel Ingersoll Pens-Men's, Ladies' or Junior Model $1.00

Oversize Ingersoll Beauties, Red, Black or Green Durrac Barrels (model shown) . . . $2.00

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If your dealer is not yet stocked with the complete Ingersoll Line, send us correct price for model desired (men's, ladies', juniors) specifying color, and we will fill your order direct.

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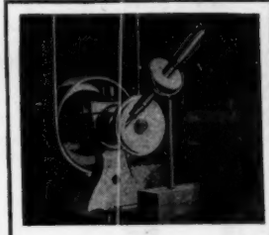

Officially Tested
By PROF.
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of the staff of the
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of TECHNOLOGY
for the "Y. C. LAB."

Everybody knows that all the wear of a pen comes on its point.

Prof. Young recently proved the everlasting wearing quality of the hard Iridium tipped points of Ingersoll fountain pens by grinding 10 of them for one solid hour each on a whirling grindstone.

Not one Ingersoll point was injured by this drastic test—equivalent to 15 miles of wear over a surface gritty enough to grind the hardest metals.

Ten common steel pen points—far more durable than the average fountain pen with soft gold point—subjected to the same test, were each rendered absolutely useless in a few seconds!

Scientific calculations show that it would take 21 years of writing at the rate of 30 words a minute day in and day out for TEN HOURS A DAY to inflict the same amount of wear as this single hour on the grindstone!

Ingersoll

$1 - $1.50 and $2.00 PENS

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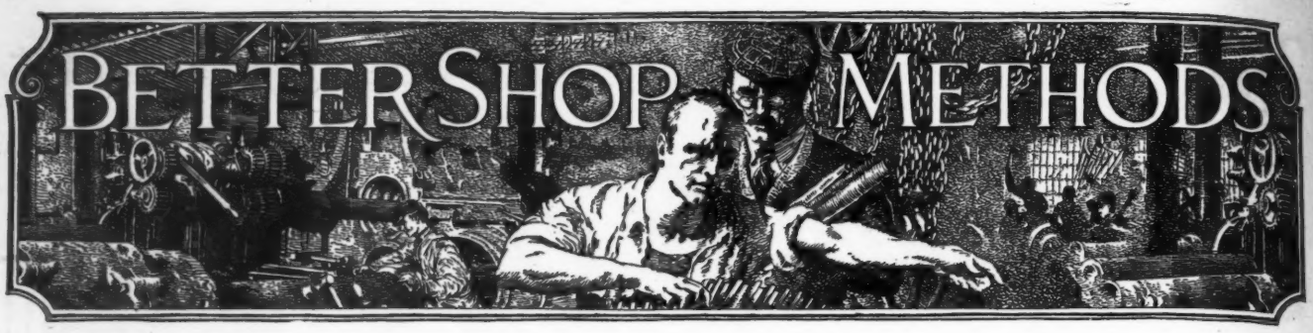


Making the Most of the Vee

Easily Made Fixtures Help You to Locate Round Work for Drilling, Milling and Boring

By HENRY SIMON

ONE of the stepchildren of the shop is the vee-block. But so long as things are turned from metal, vees will be used for some of the operations on them. Almost every shop owns one or two sets of such blocks of conventional design, with the usual clamps, and very good tools they are. As a rule, however, the possibilities of the vee as an aid to the machinist and toolmaker are not fully appreciated.

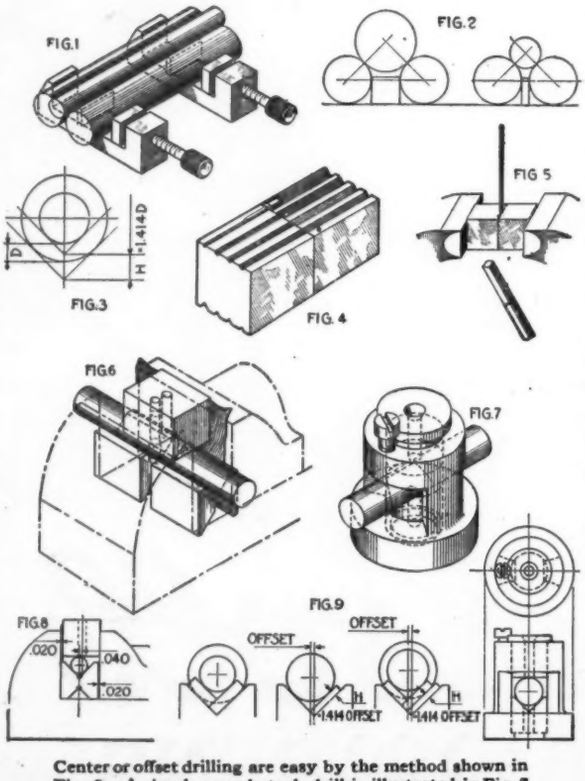
The vee has one outstanding advantage. It automatically and accurately centers round work irrespective of variations in diameter. That this is an extremely valuable feature is realized when we consider that any other means of accomplishing the same result requires mechanism of one sort or another, unless there is a semi-cylindrical bed or bearing of the exact radius of the part to be held—something which it is possible to provide only in a few cases.

The trouble with vee-blocks of ordinary design, however, is that they do not go far enough in providing for the reception, location and holding of work of a variegated nature. To try to mount a set of such blocks on the faceplate of a lathe, for instance, is to go in for a troublesome and unsatisfactory makeshift. Again, if the centering capacity of the vee is to be turned to real account, it is necessary to provide for the easy centering of the vee itself, and unless such devices are carefully thought out, they are apt to prove of questionable usefulness.

It is the purpose of this article to show some good ways of using the vee, as well as to present some simple appliances, by the use of which many an otherwise difficult job will be made easy.

Starting with the simplest, let us consider how to improve a vee, or its equivalent when none is at hand. All we require is a pair of machinist's clamps, such as are found in any shop, two lengths of cold rolled steel or drill rod, and a couple of small blocks of rectangular cross section and slightly wider than half the diameter of the rods used. By clamping these together as in Fig. 1, we have a most effective vee equivalent of practically any length we may desire, and with a passage for the drill all made. Figure 2 shows that the contact is exactly identical with that given by a regular vee, and also illustrates the approximate proportions of the three members in relation to the work. Cases may arise when vees of exceptional length are required, and this simple method furnishes a ready way of providing them. If necessary, one or two additional clamps and blocks may be used. A permanent device may also be made merely by soldering the blocks in place on the rods, so that they can be used without clamps.

Two pieces of bar stock and a pair of metal blocks will serve as a useful vee substitute



Center or offset drilling are easy by the method shown in Fig. 6. A simple round stock drill is illustrated in Fig. 7

A way in which a standard commercial pair of blocks may be used for center drilling to close limits is shown in Fig. 6. The only special accessory that is required is exceedingly simple. It consists of a block of steel of the same thickness as the vee-blocks with a hole of the required size drilled through the center of it. A second hole of about the same size is drilled laterally in line near one side. A pin with a head a trifle larger than the second hole is pushed into the "jig" block from below. The head of the pin enters the space between the two vees when the block is on top of the work. A piece of fine emery cloth is placed against the movable jaw. With the jaw lightly tightened, the work can be slid along until it is in the desired position.

The jig block is then given a smart tap, *(Continued on page 117)*

MANY timesaving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 114 to 120.

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Twinplex Stroppers
FOR SMOOTHER SHAVES

Metal Work for Beginners

Setting Up a Foot-Power Polishing Machine—Blowtorches and Heating Equipment for Soldering

By EDWARD THATCHER

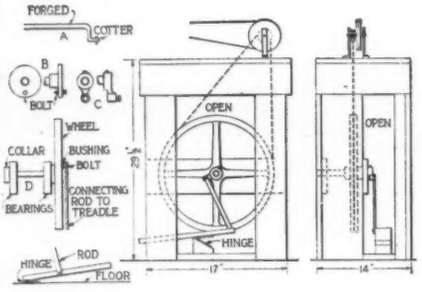
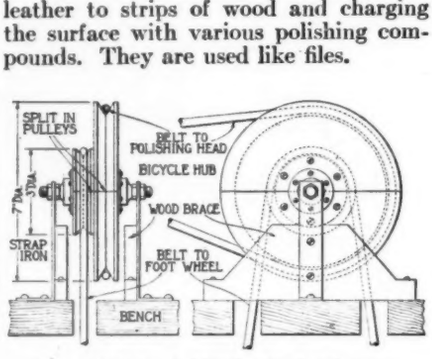


Fig. 1. High spindle speed suitable for polishing can be obtained by the use of a ball-bearing countershaft to cut down friction

IN EQUIPPING a home workshop for decorative metal work and model making, you will find many uses for a small polishing head or lathe, driven by either a foot wheel or an electric motor, together with several small polishing and buffing wheels and an emery wheel or two.

Hand buffing or polishing sticks also are valuable. These are made by gluing leather to strips of wood and charging the surface with various polishing compounds. They are used like files.



Figs. 2 and 3. A bicycle wheel hub is excellent for the countershaft. The split pulleys are held in place by screws in spoke holes

Drilling, grinding and polishing may be quickly done with a small polishing head, if the work is small, as these inexpensive tools are fitted with a drill chuck, a taper polishing spindle for buffing wheels, and nut and collars for a small emery wheel. Do not make the mistake, however, of thinking that you can polish large bowls or other bulky pieces on a small foot-driven machine or that you can use large grinding or polishing wheels on a small head. Polishing takes power, and large work is best polished by hand or on a power driven head.

A small polishing head may be mounted on the base of an old sewing machine and belted to the foot wheel, or it may be fastened on one end of the bench, with the belt passing through the holes in the bench to a foot wheel on the floor. Such foot wheels may be purchased, but it is often possible to pick up a suitable wheel at the junk yard and rig up a treadle for it. The wheel should be quite heavy and well mounted and balanced.

While a fairly high speed may be obtained from a polishing head mounted on a sewing machine base, far better work can be done if a countershaft is placed between the foot wheel and the polishing head, as shown in Fig. 1.

The writer has such a rig in his shop for small work. The ball-bearing countershaft was made of an old bicycle wheel hub on which were mounted two wooden pulleys. The spoke holes in the flanges on each side of the hub were used for the screws which hold the split pulleys to the hub (Figs. 2 and 3).

The foot wheel is 18 in., the small

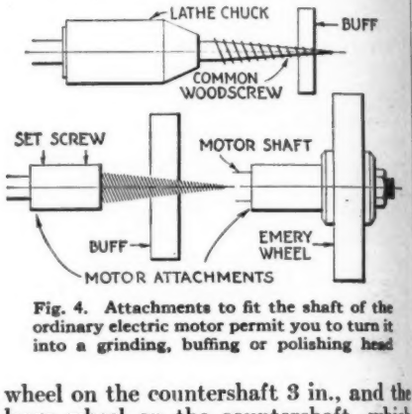


Fig. 4. Attachments to fit the shaft of the ordinary electric motor permit you to turn it into a grinding, buffing or polishing head

wheel on the countershaft 3 in., and the large wheel on the countershaft, which runs to the pulley of the spindle, is 7 in. in diameter. The pulley on the spindle is 1¾ in. in diameter, a common size.

I have made many foot power machines and used a number of commercial ones, but for speed and easy running this little

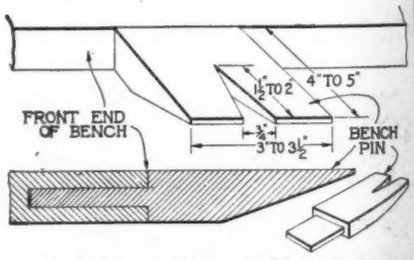


Fig. 5. A bench pin mortised into the front end of the bench is useful for many types of jobs. It should be made from sound hardwood

one with the ball-bearing countershaft beats them all.

If you make up such a rig as this, you will find that the construction of the foot treadle is important. Two suggestions are illustrated. The location of the connecting rod on *(Continued on page 132)*

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Our purpose is to interest you in this enormous Man Market. For instance, you men buy your own hats—millions of hats; you buy your own shirts and collars, underwear, hosiery, garters, shoes, clothing; you buy your own razors and shaving cream and cigarettes and cigars. You, at least, have something to say about the automobile that goes into the family garage. You buy all the trucks. You buy tires and oil and gas.

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How I Built a Desk *from* Scraps

The Secret Lies in the Method of Painting and Glazing, Which May Be Used for Any Homemade Furniture

By F. N. VANDERWALKER

WHAT can be done in the line of furniture building by one with no special training in the work is shown in the accompanying illustrations of a desk. It was made at odd times from pieces of lumber left over from the building of a new home—yellow pine, birch and oak. Some scraps of moldings were pressed into service, and the paneled back was made from a section picked up from an old building being wrecked.

Figures 1 and 2 show the completed desk with handmade hardware cut out at home from strap iron, heated in a coal burning water-tank-heater stove, and pounded into the shapes wanted. The making and finishing of the hardware is another story and will be presented later.

The inside of the desk is unusual in that the pigeonholes open from the side and not from the front. They are located behind the two side panels and consist of shelves, one above the other. By this arrangement we have none of the unsightly disorder which is apt to result when the openings are in front. In Fig. 1 is shown, too, the desk board, which slants a little to be comfortable when writing. It must be pushed back, of course, before the doors can be closed.

THE construction was done with the carpenter's tools which every handy man has. All pieces were nailed, screwed and glued firmly together, because if there is anything a homemade thing must do, it is to hang together for all time. The family is apt to overlook a failure in factory made furniture that falls apart, but not so with furniture made by dad or brother.

A piece made up of three kinds of lumber and odds and ends which in places were none too smooth, could hardly be finished in stain or natural color with good results. The defects had to be covered over and smoothed up. Consequently, the choice of finish was limited to paint or enamel. Some of the most beautiful and expensive furniture is finished in paint, and glazed and varnished or lacquered. That finish was decided upon.

The first step was to sandpaper the wood with No. 1 paper to make it as smooth as possible. Next, the surface was dusted and wiped clean with a damp cloth.

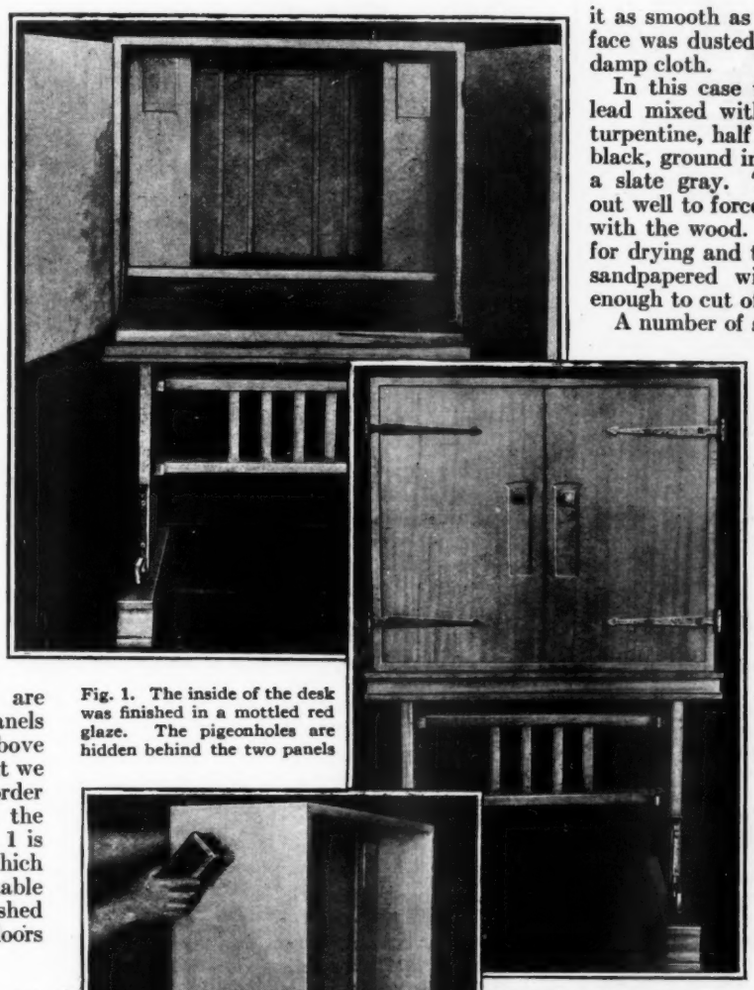

Fig. 1. The inside of the desk was finished in a mottled red glaze. The pigeonholes are hidden behind the two panels

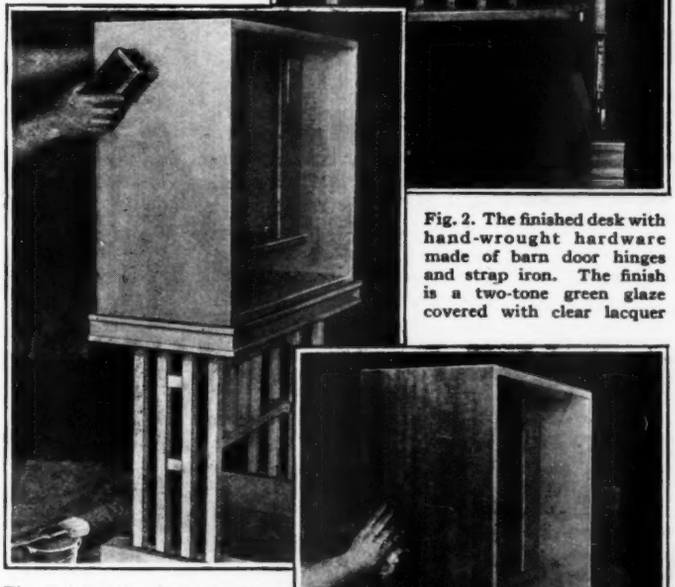

Fig. 2. The finished desk with hand-wrought hardware made of barn door hinges and strap iron. The finish is a two-tone green glaze covered with clear lacquer

Fig. 3 (above). As soon as the second coat of pea green flat paint was applied, it was patted with a stippling brush

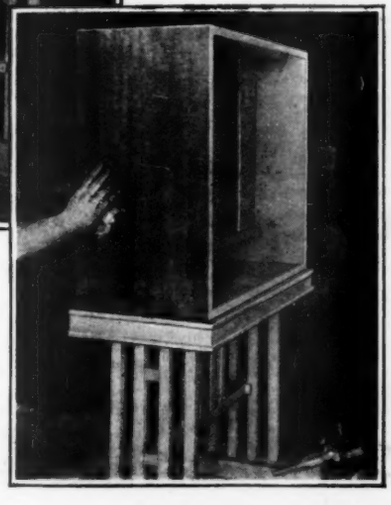

Fig. 4 (at right). The glaze-stain coat of raw umber ground in oil and turpentine is cloth-wiped to produce a pleasantly streaked finish

In this case the first coat was white lead mixed with boiled linseed oil and turpentine, half and half. A little lampblack, ground in oil, was added to make a slate gray. This paint was brushed out well to force it into intimate contact with the wood. Two days were allowed for drying and then the coat was lightly sandpapered with No. ½ paper, just enough to cut off any dust and dirt nibs.

A number of seams, joints and nail and screw holes had to be filled. This was done after the first coat of paint because putty does not stick well to new wood; the wood absorbs the oil binder out of the putty.

PUTTY for this purpose was mixed from white lead-in-oil, a little dry whiting and a few drops of floor varnish. The procedure is to spread some dry whiting on a board or pan, take a lump of the white lead paste and with a putty knife mix it into the dry whiting. When it is about like bread dough, take it up in your hands and knead it to a soft but firm consistency. Force it into all holes and cracks and smooth off with the putty knife. Let the putty dry at least overnight and sandpaper the places.

To build a smooth and level surface, the next operation is to apply two coats of what is called "automobile roughstuff filler." It is a slate colored paste which can be had from any paint store handling automobile painters' materials. Thin it to about the consistency of cream with turpentine only. Apply one coat with a 2½-in. brush, let it dry overnight and sandpaper it hard with No. ½ paper. No matter if you do cut

(*Continued on page 126*)

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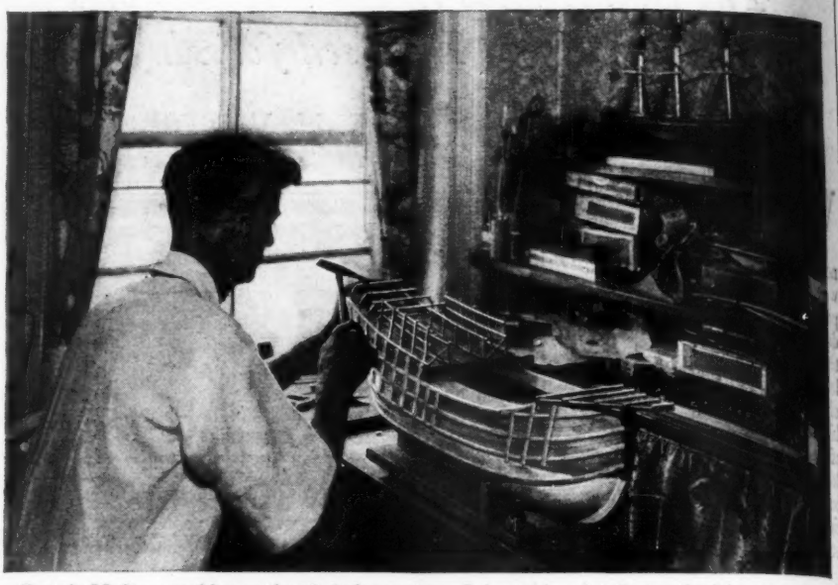
The True *Santa Maria*

(Continued from page 73)



Captain McCann working on the aft deck structure. It is at this point that authorities appear to agree that other *Santa Maria* models err. They should not have an inclosed after castle

a deplorable amount of misinformation, while models fashioned upon the same erroneous data are legion."

R. C. Anderson, the English expert, says of the model presented to the South Kensington Museum: "One should not look a gift horse in the mouth, but one may look a gift model in the rigging." He questions a bobstay in a ship of some 200 years before the generally accepted date of its introduction, the mainstay's splitting in two parts and setting up two eyebolts on the forecastle, and the shape and trim of the mizzen.

Other important features which are gravely questioned are the square tuck (lower part of the stern), inclosed after castle, the entire sail plan, rigging and most of the decoration.

One learns that Christopher Columbus encountered fanatical opposition to his mad adventure and that, despite royal mandates, no one would supply him with vessels until—to quote "Gloomy Ocean"—"Palos now offered as a second caravel a certain carack, grown old from service, named the 'Gallega'; large comparatively, and heavy, but very solid. Although improper for the service now assigned to her, neither Columbus nor his counsellor, Father Juan Perez, dared to refuse her, for fear of thus protracting the delay already too greatly extended."

Columbus could not even get this vessel properly caulked. How then would he contrive to make of her the gaily decorated, smart craft usually depicted?

Nevertheless, it was the habit to paint colorfully all manner of vessels. Sacred emblems were considered almost essential and Columbus was a High Admiral of the Ocean Sea, therefore he would be entitled to flags and banners, which would be supplied by his royal backers, and the shields of his *(Continued on page 129)*

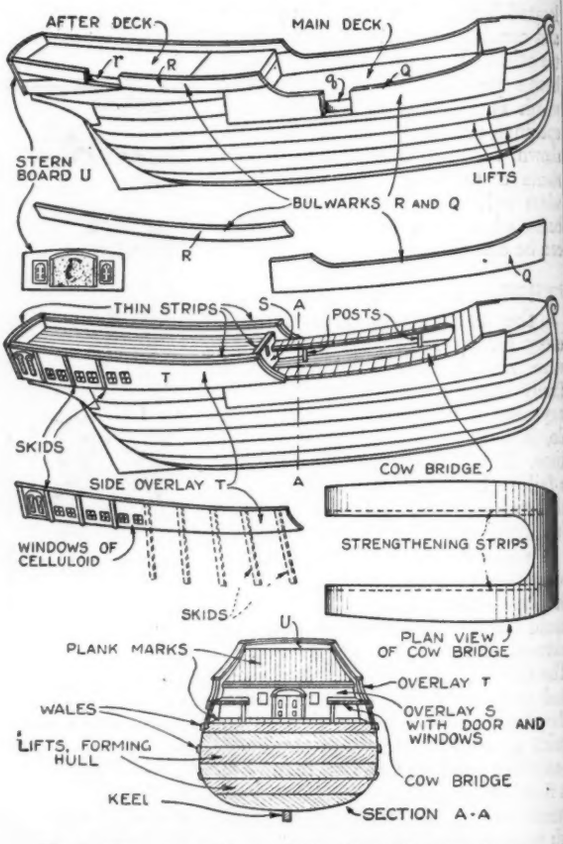


Fig. 2. The cross section and the views above it clearly show hull construction and method of fitting the decks

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Electric!

ERNST F. ALEXANDERSON
Consulting Engineer, Gen. Elec. Co.
L. W. CHUBB
Westinghouse Electric & Mfg. Co.
A. H. COLPITTS
Western Electric Co.
L. A. HAZELTINE
Inventor of the Neutrodyne
S. LOEWE
Formerly Telefunken Co., Germany
MARIUS C. A. LATOUR
Famous French Scientist
IRVING LANGMUIR
General Electric Co.
A. McL. NICHOLSON
Western Electric Co.
LEE DeFOREST
Famous Scientist

Marvelous New Electric RECEIVER *made possible by*

9 Great Engineers

THE radio inventions of famous American, French and German scientists, and inventions and patents of the foremost engineers of the laboratories of Westinghouse Electric, General Electric and Western Electric Companies have been used in the creation of the marvelous new Freed-Eisemann *Electric* 11.

Super-selectivity and Unblurred Amplification. The use of the tuned radio frequency principle as developed by Ernst F. Alexanderson in the General Electric Laboratories makes possible the marked ability of this set to sharply separate all stations. The use of Professor Hazeltine's Neutrodyne principle makes possible high amplification *without regeneration.*

Tone Quality and Simple Operation. The programs of all stations in full, beautiful tones and an amazing simplicity of operation has been insured by including in this marvelous set the inventions of Dr. Irving Langmuir, A. McL. Nicholson, Dr. Lee DeForest, Dr. S. Loewe and a number of other distinguished electric and radio research engineers.

Your Electric Light Socket Furnishes the Power. The Freed-Eisemann Electric 11 Receiver can be plugged into the light socket and it is ready for use. Do not be confused. There are many electrified sets—sets that use, in one form or another, battery power units. This new Freed-Eisemann Set is not an electrified set. It is a true electric set—there are no batteries or other accessories that need constant care.

Low Price—and Easy Payments. You know that today prices depend on quantity production. Because of the demand for this remarkable receiver we have been able to manufacture it on a volume basis that has cut production costs to a point where the Electric 11 Receiver can be sold at an amazing low price. And through our Budget Payment Plan you can have this set put in your home right now.

FREE Demonstration. Hear this new Electric Radio today—at selected better class dealers only. They will be glad to demonstrate this set IN YOUR HOME. You will be thrilled with the ability of the Electric 11 to bring into your home the programs of all the stations in full beautiful tones. A demonstration puts you under no obligation.

FREED-EISEMANN RADIO, Brooklyn, New York
Licensed under patents of Latour, Hazeltine, Radio Corporation, General Electric, Westinghouse, American Telephone & Telegraph Cos.

The New FREED-EISEMANN RADIO

ASK Any One of the Half a Million OWNERS

A Simply Made Push Sled for Baby

By ROY W. MARSH

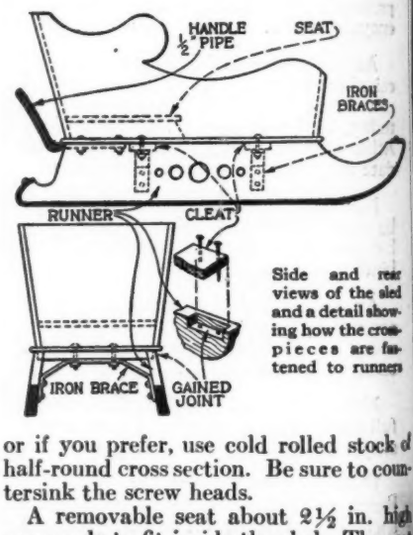
Unlike many push sleds, this requires little skill with tools to construct satisfactorily

A BABY'S push sled can be constructed with little difficulty by any handy man who follows the general method of construction illustrated.

The wooden parts required are two pieces ¾ by 6 by 36 in. for the runners, 1 piece ½ by 14 by 24 in. for the floor, 2 pieces ½ by 12 by 26 in. for the sides, 1 piece ½ by 12 by 15 in. for the back, 1 piece ½ by 6 by 14 in. for the front and 2 pieces ¾ by 2 by 12½ in. for the cross braces.

The handles were made of ½-in. gas pipe about 52 in. long. The ends were flattened where they run under the sled and bolted through the crosspieces and the bottom. The cross bar was a piece of rake handle 18 in. long with ¾-in. holes bored 1½ in. from each end to receive the ends of the gas pipe. These were fastened with rivets.

The runners should be shod with iron. Use 1/16-in. or ⅛-in. strap iron ¾ in. wide,



Side and rear views of the sled and a detail showing how the crosspieces are fastened to runners

or if you prefer, use cold rolled stock of half-round cross section. Be sure to countersink the screw heads.

A removable seat about 2½ in. high was made to fit inside the sled. The seat and the floor are covered with bound sample patches of carpet obtained for nothing at a carpet store.

The ornamental holes in the sides of the runners are ½, 1 and 1¾ in. in diameter. The finish in this case was gray brushing lacquer of a kind guaranteed to stand outdoor exposure, but automobile enamel or any other durable finish could be used.

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Silent Magic

Here is the Eveready Layerbilt "B" Battery No. 486, Eveready's longest-lasting provider of Battery Power.

Radio is better with *Battery* Power

TURN your radio dial, and presto! you turn your home into a theater, a concert hall, a lecture room, a cabaret, a church, or whatever you will. Turn the dial and your attentive ear does the rest. That is all there is to this magic of radio.

Or almost all. If a radio set is to work at its very best, attracting no attention to itself, creating for you the illusion that can be so convincing, you must pay a little attention to the kind of power you give it. There is but one direction, a simple one—use Battery Power. Only such power is steady, uniform, silent. It is called by scientists pure Direct Current. Any other kind of current in your radio set may put a hum into the purest note of a flute, a scratch into the song of the greatest singer, a rattle into the voice of any orator.

Don't tamper with tone. Beware of interfering with illusion. Power that reveals its presence by its noise is like a magician's assistant who gives the trick away. Use batteries—use the Eveready Layerbilt "B" Battery No. 486, the remarkable battery whose exclusive, patented construction makes it last longest. It offers you the gift of convenience, a gift that you will appreciate almost as much as you will cherish the perfection of reception that only Battery Power makes possible.

EVEREADY Radio Batteries *—they last longer*

NATIONAL CARBON CO., INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

WEAF—*New York*
WJAR—*Providence*
WEEI—*Boston*
WFI—*Philadelphia*
WGR—*Buffalo*
WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WTAM—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
KSD—*St. Louis*
WCCO—*Minneapolis* / *St. Paul*
WDAF—*Kansas City*
WRC—*Washington*
WGY—*Schenectady*
WHAS—*Louisville*
WSB—*Atlanta*
WSM—*Nashville*
WMC—*Memphis*

Pacific Coast Stations—9 P. M., Pacific Standard Time

KPO—KGO—*San Francisco*
KFOA—KOMO—*Seattle*
KFI—*Los Angeles*
KGW—*Portland*

The air is full of things you shouldn't miss

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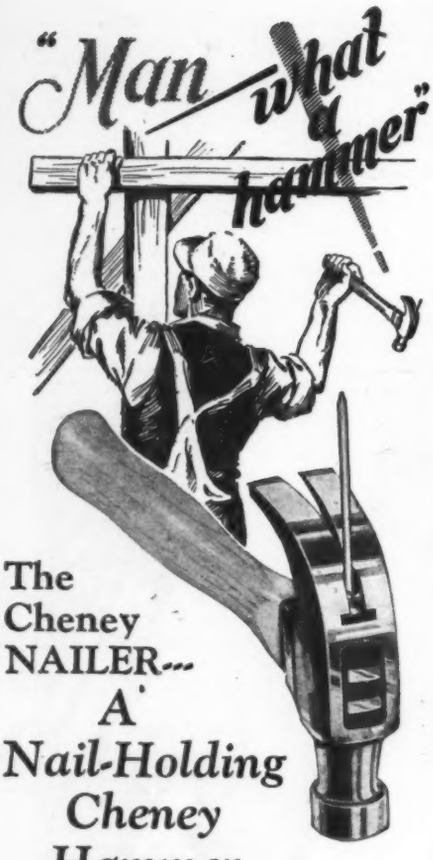
"Man what a hammer"



The Cheney NAILER— A Nail-Holding Cheney Hammer

Here's a regular Cheney Claw Hammer with a practical nail-holding arrangement that's the handiest hammer feature you've ever seen.

With the Cheney Nailer you can set and drive nails high above your head with one hand. Any wire nails up to No. 30's are firmly held and easily released when set. The Cheney Nailer eliminates much scaffolding danger and prevents many bruised fingers.

You'll find every other good Cheney Hammer feature in the wonderful Cheney Nailer, too—drop-forged tool-steel head perfectly tempered, strong hickory handle with a man's grip, and a beautiful balance or "hang" that's easy on the wrist. Ask your dealer today for a remarkable time-saving, labor-saving Cheney Nailer.

PRENTISS VISES
PRENTISS
106-110 LAFAYETTE ST. NEW YORK CITY
VISE CO.
CHENEY HAMMERS

1299

Restoring Antique Furniture

An Expert Repairer of Old Pieces Reveals His Secrets—How to Preserve the Original Patina

By R. C. STANLEY

Many old pieces of furniture stored in attics can be returned to service as valuable antiques if they are properly repaired and restored

IN THIS day of the "antique craze" a great many amateur mechanics are attempting to repair and refinish old furniture. To these I shall endeavor to impart some of the knowledge gained through long experience in this work. What I write is not merely personal opinion, but includes a lot learned from others and now used in my own shop.

The first and most essential thing to know is what constitutes antique value. This, of course, is the appearance of age. Destroy the old look and the value of the piece as an antique is destroyed. What gives wood its appearance of age is a change that comes over the surface after long exposure. The popular name for this appearance of the surface is "patina." Diluted nitric acid is sometimes employed to give wood an artificial patina. The treatment is unsatisfactory, however, as there is nothing natural about the film's appearance.

IN SOME pieces of furniture the name of the famous old maker gives them their value, but the ordinary piece, such as most of us own, derives most of its value from its original patina, hence the importance of preserving the surface in its original state.

Now that we understand the necessity of preserving the patina, we shall see how shellac, varnish, and other finishes may be removed, leaving the patina intact. But first let me insert a few don'ts:

Don't plane the surface to be preserved; don't do any indiscriminate and hurried scraping; don't use any solution containing concentrated lye; don't start work until you have given it a very thorough examination to determine its needs, for it will be found that every job of this kind is different from every other one; don't, after the job is started, try to hurry it—if you feel impatient to have the job done, dig some bait and go fishing.

THE patina has the same color in all woods, and the older the piece, the more marked it becomes. It is recognized by its smooth, mellow, yellowish tinge, but it is transparent. To those who do not recognize this surface condition, it is almost impossible to describe it unless one is looking directly at an old piece; then, of course, it can be shown and does not have to be described.

To remove old finishes of paint and varnish, always use a good grade of paint and varnish remover. Apply the remover generously with a brush, but do no more brushing than is necessary. The coating absorbs the remover and becomes soft. Leave it for a sufficient length of time, which varies according to the thickness and nature of the coat to be removed. This may be determined by scraping spots the size of a dime. When the action is found to be complete, remove the finish from flat surfaces with a dull scraper, a *(Continued on page 127)*

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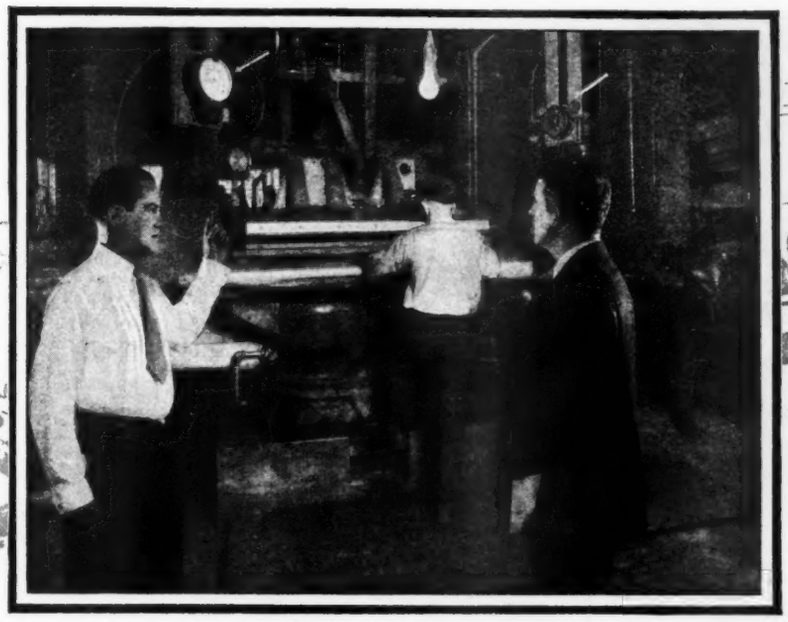

Tycos, the Sixth Sense Saves Money and Insures Quality

IN MAKING shoe leather accurate temperature regulation is essential—if the plate in the hydraulic press is too cold the work has to be done over; if too hot the quality of the leather is impaired.

One manufacturer of shoe leather has increased his production, improved quality and saves $936 annually by using the scientific accuracy of *Tycos*, the Sixth Sense of Industry instead of the guess work of old methods. And through the use of *Tycos* Instruments for indicating, recording and controlling temperatures this manufacturer has insured absolute uniform quality for his products.

In these days of mass production and heavy competitive selling *Tycos* Instruments insure an absolute uniformity of heat treated products that is essential to success.

Whatever you make if your manufacturing problems require the indicating, recording or controlling of temperature, there is a type and style of instruments in the *Tycos* Line of 8,000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request. Or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Tycos for the Home

***Tycos** Office Thermometers*
An aid in promoting human efficiency.

***Tycos** Bath Thermometers*
To enable you to get the most good from your bath.

***Taylor** Home Set*
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

***Tycos** Wall Thermometers*
To help you maintain a temperature in your house conducive to good health.

***Taylor** Quality Compasses*
To show you the right way in unfamiliar country.

***Tycos** Fever Thermometers*
A necessity in every home.

***Tycos** Stormoguide*
Forecasts the weather twenty-four hours ahead with dependable accuracy.

***Tycos** Hygrometer*
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos for the Medical Profession

***Tycos** Sphygmomanometer, Pocket and Office types.*
***Tycos** Urinalysis Glassware.*
***Tycos** Fever Thermometers.*

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Write for Bulletin

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. - - U.S.A.
Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd. Manufacturing Distributors in Great Britain

THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY

Tycos Temperature Instruments

INDICATING - RECORDING - CONTROLLING

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A New Service
to the readers of
POPULAR SCIENCE
by
Hammacher, Schlemmer & Co
National Headquarters
for the finest in
HARDWARE
AND TOOLS

HAVEN'T you often wished you had a store right in your own neighborhood where you could pick out exactly the tools you needed?

From now on you will have!

For all practical purposes Hammacher, Schlemmer & Co., the largest hardware store in New York, is moving into your community, putting at your command its entire stock of over 125,000 items including *most* of the manufactured brands advertised in this magazine.

Fitted Tool Chest No. 152 with 24 Tools—$27.00

Whatever you require in the way of quality tools, we will send you—anything from a special type plier to a fully equipped work bench.

Fitted Tool Chest No. 52 with 24 Tools—$25.00

100-Page Tool Book FREE!

Just clip this coupon and send it to us. It will bring you one of the most interesting catalogs you've ever seen—100 pages of facts about Tools for the Home Workshop.

Hammacher, Schlemmer & Co.
Please send me, free of cost, your catalog No. 615-P, describing your Tools for the Home Workshop.

Name .....
Address .....
City ..... State ..... PS 12

Hammacher, Schlemmer & Co.
4th Ave. *at* 13th Street
New York, N. Y.
Since 1848

Hints on Laying Out a Home Workshop Compactly

By A. W. Woehr

Fig. 1. Bench for woodworking, storage shelves, movable droplight and tool racks

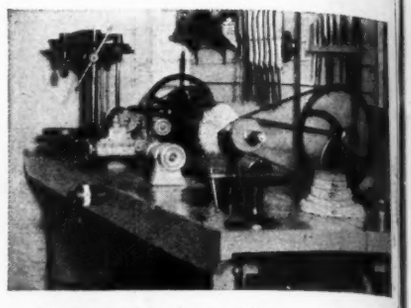

Fig. 2. Bench for lathe, drill press and grinder. The motor is underneath the far end

THROUGH the installation of an oil burner, the coal bin space in my cellar became available for a workshop. At small expense I converted it into the shop illustrated. There is a space of about 3 ft. in front of the benches.

The general arrangement is shown with sufficient clearness in the illustration, but there are two or three features which may be mentioned, as they may appeal to other home workshop enthusiasts who have not adopted corresponding devices.

Where one has a long shelf over a bench a handy and readily moved droplight may be fashioned in a short time from a few pieces of wood, as shown in Figs. 1 and 3. The advantages are that the light may be quickly moved to any part of the bench and the height can be regulated.

One of the best arrangements I have found for keeping tacks, brads, nails, staples, screws and a hundred and one other small odds and ends is also illustrated in Figs. 1 and 3. A number of empty mayonnaise jars of various sizes are collected and cleaned and the labels removed. These glasses form ideal containers, because the contents can be seen at a glance and in most cases no identifying labels are necessary. The covers with their paper pads close so tightly that they protect the contents from moisture.

A rack for keeping these jars in an orderly fashion may be made like that illustrated. A small strip of wood about ¼ by 1¼ in. is placed in front of each shelf to keep the jars from sliding off.

Over the benches in Figs. 1 and 2 are shown tool racks which can be removed bodily from the wall. This is better than hanging the individual tool holders directly on the wall because of the work it saves if the shop has to be moved or rearranged. The clips for chisels, files, screw drivers and similar tools are patented tool holders obtainable in hardware stores, while the holders for hammers, shears, saws and the like are straight hooks or cup hooks. These are fastened to strips of wood, which in turn are fastened to the wall.

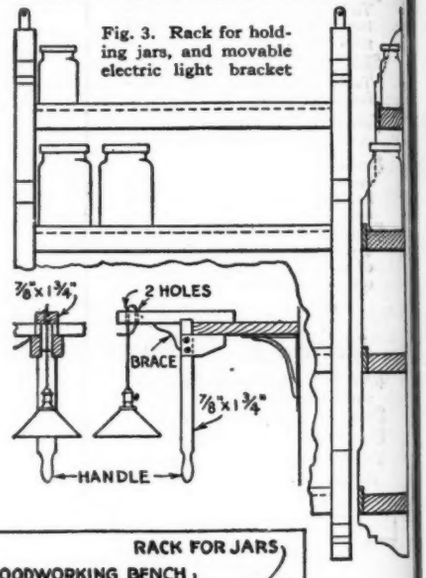

Fig. 3. Rack for holding jars, and movable electric light bracket

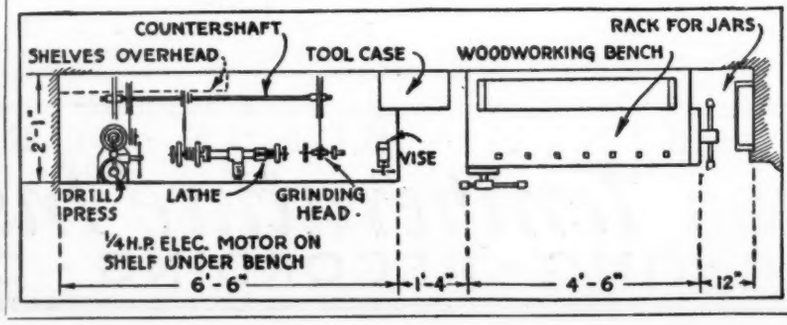

Fig. 4. Plan view of workshop in cellar

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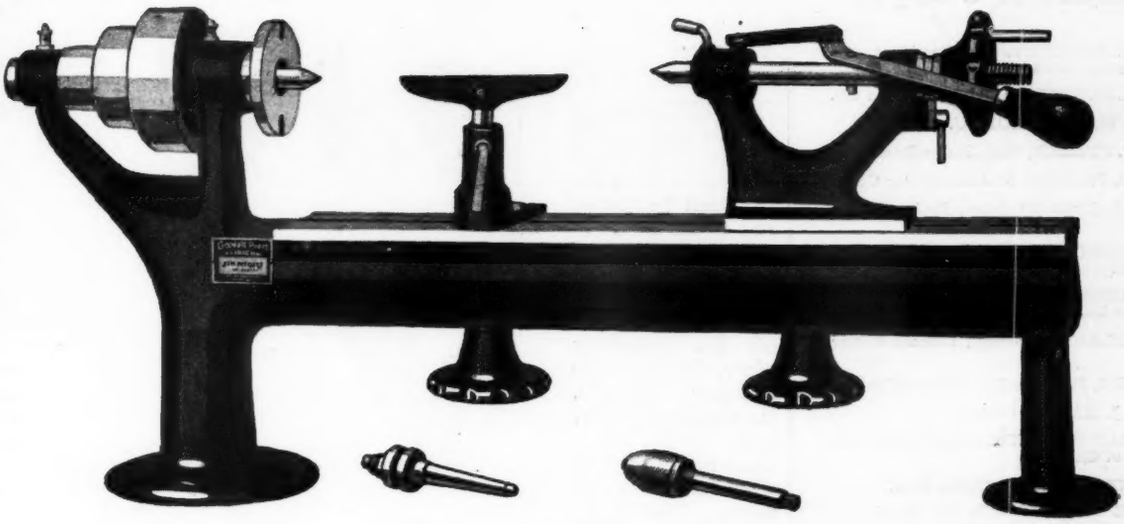
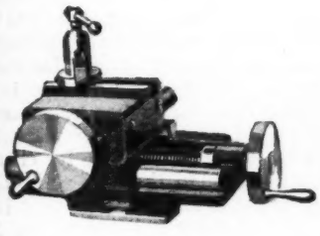
A *reliable* BENCH LATHE at a price you can afford



No. 125—$40



No. 132 Slide Rest
List $17.50

IF you don't require ultra precision, but do want a reasonably accurate lathe, this one will serve your purpose and meet your pocketbook.

This lathe is sturdily built and dependable, and is designed especially for use in trade schools, repair shops and the home work shop.

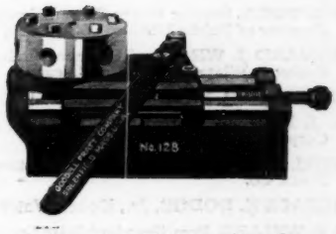
It has Milled Bed and Tail Stock with Milled Base, both Screw and Lever Feed and 3-Step Cone Pulley. Capacity: 7″ swing; 12″ between centers. Live Spindle fitted with cone bearing. Measures 25″ over all and is 11½″ high.

No. 125 . . . . List $40.00.

No. 494 Bench Lathe is similar, but has larger T Rest and longer bed. Capacity 7″ swing; 18″ between centers. List $44.00.

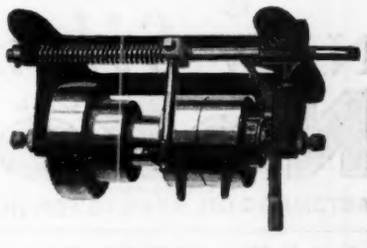
Either lathe can be driven by a ¼ H.P. motor.

Ask to see these Lathes and Accessories at your dealer's. Or write us for Lathe Booklet, which will be sent FREE on request.



No. 128 Turret Attachment. List $50.00

No. 194 Saw Table
(saw not included)
List $17.50



No. 130 Countershaft
List $12.00

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

MAKERS OF *Toolsmiths* MR. PUNCH

GOODELL-PRATT

1500 GOOD TOOLS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS See page 6.

NOKOL Oil Heat

is preferred by these Nationally Prominent People

COL. J. G. VINCENT, Vice-President and Chief Engineer Packard Motor Car Co.

SEWELL L. AVERY, Pres. U. S. Gypsum Co.

ADMIRAL W. S. BENSON, U. S. N.

ALFRED C. FULLER, Pres., Fuller Brush Co.

R. E. OLDS, President, Reo Motor Car Co.

EDWARD S. JORDAN, Pres., Jordan Motor Car Co.

A. D. GEOGHEGAN, Mfr. of Snowdrift and Wesson Oil

E. W. SEAHOLM, Chief Engineer Cadillac Motor Car Co.

HENRY LELAND, Ex-Pres., Lincoln Motor Car Co.

L. P. FISHER, Pres., Cadillac Motor Car Co.

BISHOP J. J. HARTY, Omaha

DR. HERMAN N. BUNDESEN, Health Commissioner of Chicago

F. J. HAYNES, President, Dodge Bros.

CLARENCE H. HOWARD, Sr., President, Commonwealth Steel Corporation, St. Louis

HON. HERBERT S. HADLEY, Chancellor Washington University, St. Louis

JUDSON S. BEMIS, Pres., Bemis Bag Co.

E. E. WALL, Former Water Commissioner and Director of Public Utilities of St. Louis

HOWARD J. WHITE of Graham, Anderson, Probst & White, Architects, Chicago

WM. FISHER, President, Fisher Body Corp.

A. J. FISHER, Chief Engineer, Fisher Body Corp.

BENJ. GOTFREDSON, Pres., Gotfredson Truck Co.

HORACE E. DODGE, Jr., Dodge Water Cars

B. R. WELLER, Pres. Standard Oil of Louisiana

DR. LEE DeFOREST, Famed Radio Inventor

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* * *

Nokol is preferred in your locality too. Write for free booklet on oil heat and details of our attractive budget plan.

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AUTOMATIC OIL HEATING FOR HOMES

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AMERICAN NOKOL COMPANY
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Please send me your new book on oil heat and details of your budget plan.

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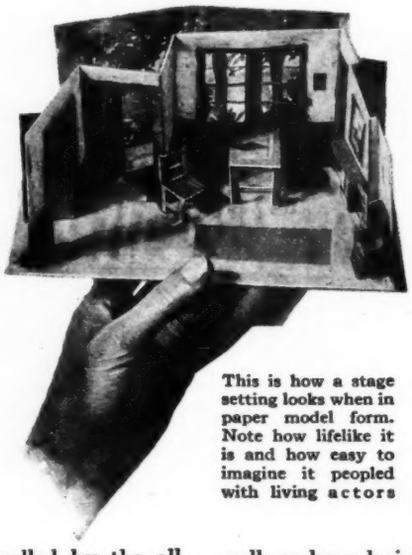
Oldest and soundest automatic oil burner manufacturer in the world

Paper Models Help Design Amateur Stage Settings

By ANDRE SMITH
Author of "The Scenewright"

Second of a Series of Articles on Amateur Theatrical Scenery



This is how a stage setting looks when in paper model form. Note how lifelike it is and how easy to imagine it peopled with living actors

IN THE first article of this series Jerry, the stage carpenter, was introduced to you as one of the most important members of an amateur play-producing group. I showed him up in all his three-way glory, that is, as the designer of the sets, the builder of them, and, more often than not, the man who has to paint them. This triple personality has been called by the all-inclusive name of "scenewright," and for convenience of designation I shall hereafter refer to him by this dignified title.

Since in these articles my object is to introduce the amateur scenewright to the three divisions of his work, suggest to him the possibilities of his job rather than the full scope of it, I had best begin at the beginning and show you the scenewright in the first phase of his work: as the designer of sets.

If the scenewright happens to have had any sort of training as a draftsman, especially an architectural draftsman, his job as designer will be comparatively easy. He will know then how to handle drafting instruments, the T-square, triangle, and the architect's scale (or rule), and be able to lay out his floor plans and make the "working drawings" for his scene frames. But he need not have this special training in order to do the job; almost anyone with paper, pencil and a ruler can make the necessary drawings. Even if your drawings are a little sketchy and faltering in draftsmanship, you need only remember that a good setting can emerge from a poor drawing as well as from one that is neatly and carefully done. It is not the drawing that counts, but the idea that the drawing embodies.

When the scenewright's ideas are commonplace, the settings will also be commonplace. But if the scenewright has read the play carefully, thought about it, talked it over with the director, made sure what will be needed not only to satisfy the exact requirements of the play but also to add the quality of "atmosphere" to his sets, he will be certain to create something above the ordinary, a setting worthy of the attention of even a critical audience. And some night when the curtain goes up on one of his sets, and even before a word is spoken, he will hear the audience break into applause and know then that his thoroughness has not been in vain.

So I shall assume that all scenewrights are willing to give that "overtime" quality of thoroughness to their work that makes for success. In that case the scenewright won't be satisfied merely to make a plan of his sets and draw up the side walls or boundaries, but will want to follow up his drawings with a model. He may at first think this an unnecessary addition to his labors. As a matter of fact it is quite the opposite; it is labor-saving in that it gives the scenewright (as well as the director and actors) a chance to see the settings in miniature, to visualize the background of the play before the actual sets are built. It allows also for changes and modification in the sets while these changes are still easily made, that is, in the model instead of the actual sets. And the model also gives the scenewright and his assistants the assurance of the outcome of their labors. They realize that instead of working from more or less mysterious drawings, they need only to enlarge the model to full size and the job is done. In brief, the model allows them to see "where they are at," to know what is expected of them and why.

I cannot stress this point too much since I have tried both methods, without a model and with a model, and the model method is always the better in every way. The model stands ready at all times to settle doubts and arguments. If a question arises about the building of a certain frame in a certain way, the answer is to be found in the model. And later, when the frames are made, covered and painted and are ready to be set up, the model again shows even better than a plan or a sketch how the various frames are to be joined, the angles of the walls, and other details of alignment.

Now, a model can vary from a strip of paper folded in such a way as to show the corners of the room, with windows and doors roughly sketched in, to an elaborately-drawn, painted and furnished creation. The degree of elaboration is entirely up to the *(Continued on page 92)*

(IS) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

$55.

At this price the Crosley Bandbox is Radio's most astonishing success, *not* because the price is low, *but* because the set is magic!

The ability of the new Bandbox is amazing. Its simple operation is easily understood and its wonderful performance is at the command of any hand that can turn the dial.

Millions are making up their minds today to buy a radio.

Millions will replace obsolete sets with new, up-to-date receivers this fall.

Experienced radio owners will look first for 3 fundamental points and to every set they consider will address these questions:

1. Is it selective?
2. Is it sensitive?
3. Is it easy to operate?

Satisfied on these points they will look for:

1. Single dial control
2. Illuminated dial
3. Volume control
4. Single cable leads
5. Console installation adaptability
6. Reasonable price.

Millions will look at the Crosley Band box. This amazing little set is now displayed by more than 16,000 dealers.

One dealer, alone, expects to sell a million dollars worth of Bandboxes this season.

Crosley dealers from Maine to California have this wonderful receiver hooked up for immediate demonstration and will explain its matchless performance in a manner somewhat like this:

The Crosley Bandbox is a 6-tube receiver.

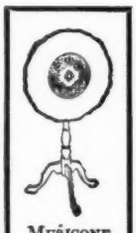
The circuit of this set is of the excellence you would expect from a group of skilled engineers suddenly given the pick of the world's radio patents to work with.

Crosley has always given the radio world its biggest value for its dollar. Contemplate the perfection possible when the doors of the research and development laboratories of The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone & Telegraph Co., and the Hazeltine and Latour Corporations were thrown open.

Licensed under their patents!

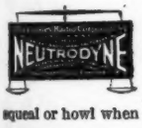
Tremendous! Wonderful! Significant!

Simply it means that millions will possess the best radio performance possible at the low prices for which Crosley is already famous.



MUSICONE TILT-TABLE $27.50

The Crosley Bandbox is totally and completely shielded. Every element is absolutely separated from every other element by solid shielding. Coils are covered with copper. This could have been done cheaper but efficiency would have been sacrificed. Condensers are housed in cadmium-plated steel. All wiring is separated and shielded from all other parts of the receiver. Solid, sturdy, substantial, the entire set is assembled on a heavy metal chassis.



The tuned radio frequency amplification stages have been absolutely balanced through use of the Neutrodyne principle. The set is a genuine Neutrodyne!

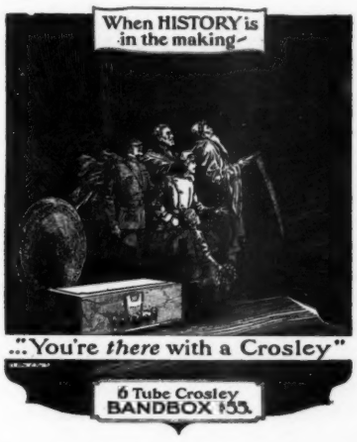
To the initiated this means much. To the layman it manifests itself only as a radio receiver that does not squeal or howl when you are trying to get a station.

The foregoing answers for the Crosley Bandbox the three fundamental questions set forth in the fourth paragraph, which the experienced radio owner is asking of every set he sees this fall.

The shielding makes the Bandbox highly selective—the circuit, acutely sensitive and the design, extremely easy to operate.

The Bandbox is operated with a single station selector (one dial).

In most localities and in most owners' hands the single station selector will find all the programs anyone could possibly wish. But there are some owners who demand greater ability like the possessors of 90 horse power motor cars who may never step on it but like to be conscious it's there. For such have the Acuminators been designed. Far away stations of weak power but perhaps good music are captured by the use of these little auxiliary tuners. Their function is best likened to a pair of field glasses. As the lens bring the distant scene to nearby aspect, so do the acuminators bring the remote station



signals up to room-filling volume. Ordinary one-dial radios can never perform like this. Hair-line tracking of the condensers together is difficult—but the Acuminators, little secondary adjustments *exclusive* to Crosley give the Bandbox a substantial command of the air and *all* that is in it.

The dial of the Bandbox is illuminated. A detail! A refinement added but not as an excuse to raise the price. For shadowy corners and dim eyesight it recommends itself.

Volume Control is necessary on good radio today. Nearby and high-powered stations send terrific impulses into the receiver. Detuning has been a favorite method of softening this loud reception but with stations closer and closer together on the dial detuning particularly in large cities creates an overlapping of programs. The ear like the eye is only good for one thing at a time. Under the towers of the heaviest stations the volume control of the Bandbox cuts the loudest blast down to a veritable whisper. No distortion whatsoever!

A single cable leads all outside and power connections from the Bandbox. In this brown fabric-covered cable lies each lead covered with colored rubber for protection, accuracy, and easy assembly. Tidy housewives appreciate it.

The adaptability of the Bandbox to installation in all types of cabinets is a feature. The metal case of the Bandbox lifts off the chassis. This leaves the closely grouped dial, switch and volume control shafts to be stuck through holes in the panel of any sort of cabinet. The escutcheon is quickly screwed over them and the console installation is not only complete but has no earmarks of a makeshift.

Much has influenced the $55 price of the Bandbox.

First, an ideal and an idea.

Then, a working out of the idea.

And now, the constant possession of the ideal.

Back before radio became the entertainment force it is today Powel Crosley, Jr., held an ideal that the things which give people pleasure should be made to sell at low prices so that millions may enjoy them.

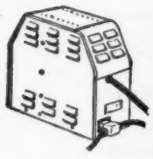
When radio was a bundle of hairpins turned with the knobs from typewriter carriages, he had the idea that if he could make radios in sufficient quantities, he could supply millions with a means of enjoying this new source of pleasure at moderate prices.

Every radio year has been a year of mass production experience to Crosley. This year saw an investment of over half a million dollars in equipment that a fine radio might be made at such speed and in such quantities that a price of nearly half a hundred dollars could be maintained.

Throughout the country millions examine the Bandbox today. They see it the achievement of an organization who began its development when radio as we know it today began. Its success has been tremendous if clamorous demands from dealers are any indication. Skeptics, the unbiased and the radio wise have pronounced it GREAT. Even at any price it would be a sensation, for its performance ranks with the most expensive and fanciest radio receivers on the market.

An AC model Bandbox takes its power from the electric light.

Former power supply with its constant annoyance and expense is entirely eliminated.



POWER CONVERTER $60

The new R.C.A. AC tubes provide clear, smooth and loud reception comparable in every way to the most efficient wet storage battery power.

Alternating current ripple is smoothed out in the compact little power converter which is sold with the AC Bandbox. This device needs no attention—is half the size of an ordinary storage "A" battery and matches the Bandbox in finish and color.

The AC Bandbox is $65

The Power Converter is $60

This gives you a complete, direct AC radio adaptable to any type of installation you may choose—bookcase, console, desk, cabinet, arm-chair or tuck it away on the corner of the table—for $125.00.

THE CROSLEY MUSICONES ARE AS OUTSTANDING IN THEIR FIELD AS THE BANDBOX IS IN ITS

Back in early 1925 radio's audibility above the single telephone ear unit depended upon a horn. Unnatural and harsh it laid a handicap on a fast developing industry. Only at great cost could its limitation be surmounted. Suddenly Crosley offered the radio world a cone speaker at $17.50. Instantly the demand exceeded the supply. Promptly loud speaker sales were gauged by the leadership of the Musicone.

Today that position is still maintained. The cause is plain. Mechanical refinement and improvements of the Musicone since its inception have been constant and considerable.

Price of the Musicone has shown a steady downward trend from $17.50 in 1925 down to $9.75 at the present time.

Only a national acceptance could make this possible and only a remarkable value could create such a national acceptance.

Today the Musicone is a perfect reproducer through—

1. A new metallurgical discovery giving many times the vibrating capacity of the actuating unit as formerly.
2. Bakelite coil cores impervious to moisture.
3. Secretly coated wire that does not permit deterioration in damp climates.

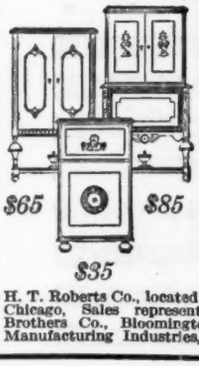
Crosley owners find a perfect affinity between the Bandbox and the Musicone aside from their physical appearance.

The musicone is sold in two sizes:

The Ultra Musicone (12-inch).....$9.75

The Super Musicone, as illustrated (16-inch)....$12.75

APPROVED CONSOLES



"I want the public to have as great a value in consoles this year as I have given them in the Bandbox," said Powel Crosley, Jr.

Prominent furniture manufacturers thru their long experience promised beautiful cabinets at moderate prices. Designs submitted were admired, praised, tested, approved! The Musicones were built in. Crosley dealers now sell them. Purchasers may know they are best suited for Crosley radio by looking for the "approved label" in each one. Crosley dealers get these cabinets only from The H. T. Roberts Co., located at 1340 S. Michigan Ave., Chicago, Sales representative for The Showers Brothers Co., Bloomington, Ind., and The Wolf Manufacturing Industries, Kokomo, Ind.

Write Dept. 17 for descriptive literature

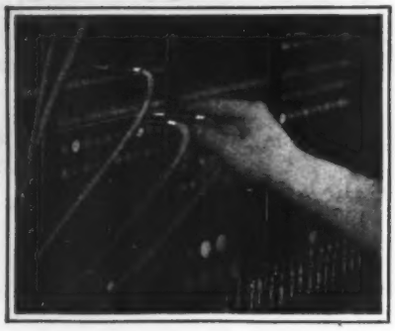
CROSLEY RADIO

THE CROSLEY RADIO CORP.
Powel Crosley, Jr., Pres.
Cincinnati, Ohio

Crosley is licensed only for Radio Amateur, Experimental and Broadcast Reception.

Montana, Wyoming, Colorado, New Mexico, and West prices slightly higher.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



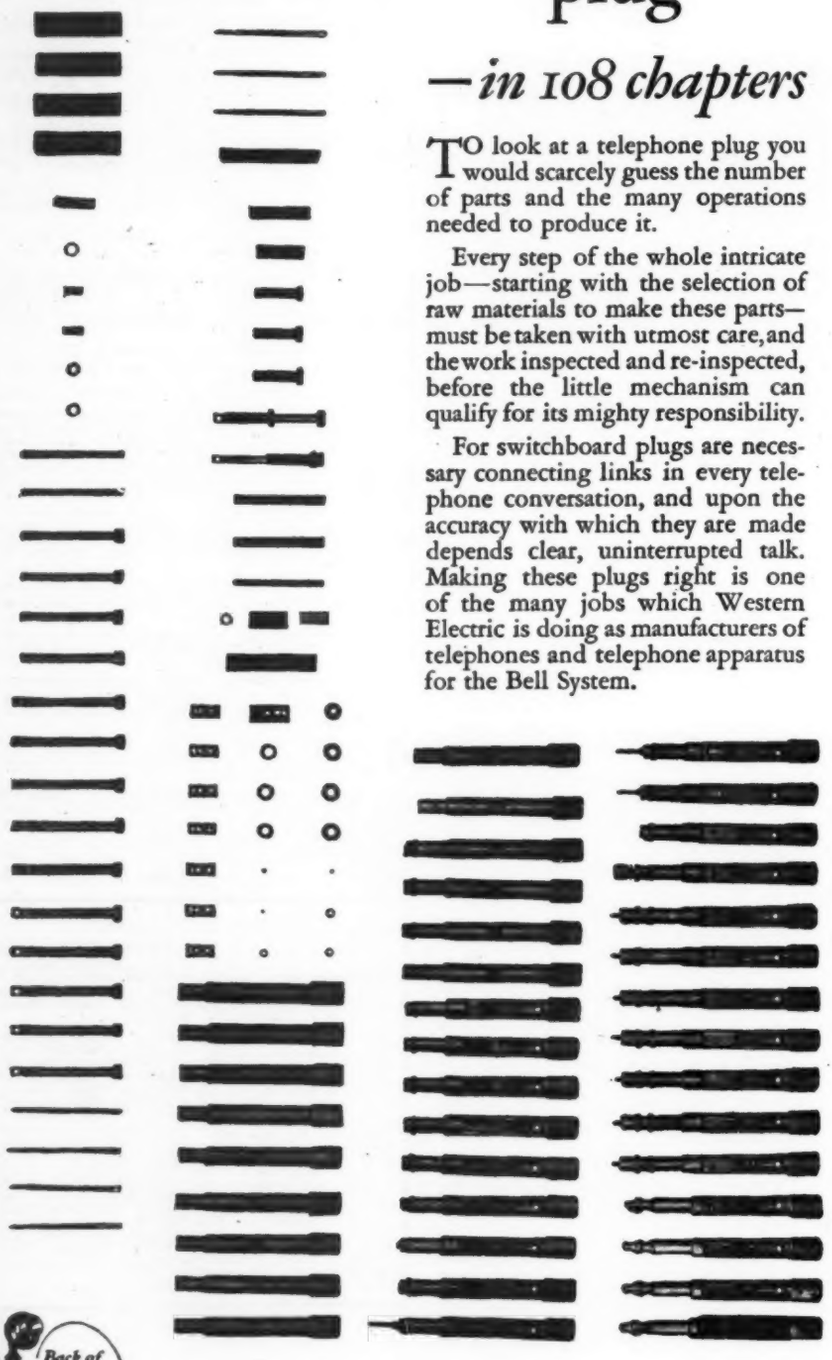
The evolution of a switchboard plug

—*in 108 chapters*

TO look at a telephone plug you would scarcely guess the number of parts and the many operations needed to produce it.

Every step of the whole intricate job—starting with the selection of raw materials to make these parts—must be taken with utmost care, and the work inspected and re-inspected, before the little mechanism can qualify for its mighty responsibility.

For switchboard plugs are necessary connecting links in every telephone conversation, and upon the accuracy with which they are made depends clear, uninterrupted talk. Making these plugs right is one of the many jobs which Western Electric is doing as manufacturers of telephones and telephone apparatus for the Bell System.



Western Electric

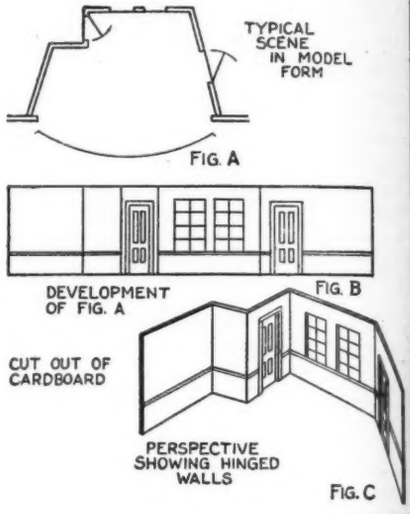
Since 1882 Manufacturers for the Bell System

Paper Models Help Design Stage Settings

(*Continued from page 90*)

scenewright. If a rough model is all he needs to help him visualize his finished sets, well and good; if he wishes to enjoy the satisfaction that comes from any job well done, I urge him to make his models with considerable care. This additional effort is sure to be reflected in the actual finished sets. They will look as if they were designed rather than just thrown together. They will possess a structural quality and finish.

If you will look at the accompanying diagram you will see the development of a model in its very simplest form. A shows the stage and the floor plan of the room; B, a development in elevation of the three walls; C, how these walls will



The three preliminary operations in designing a stage setting. The finished paper model is worked up from these drawings

look when cut out and folded according to the floor plan. All models of interior sets are based upon this principle of working from a floor plan, by way of the developed side walls, to the folded "room." To insure accuracy these three walls can be set up on the drawing of the floor plan, but this is helpful only in an elaborate interior where the walls have unusual recesses or projections, or must slope at a particular angle.

If our student scenewright will now take the trouble to make a model box, drawing it to scale with the stage for which he is designing his sets, designating especially the width and height of the proscenium opening before cutting it out, he can then place his model into this box and see how the sets will appear later when, by the magic of enlargement and a little hard work, they will stand actually on the real stage. For that reason and in order to make certain of his visualization and the outcome of his sketches, he should make his model as nearly as possible a miniature of the finished sets. This is especially true in the case of the beginner.

In making a model the most convenient scale at which to work is one half inch to the foot. The paper (*Continued on page 188*)

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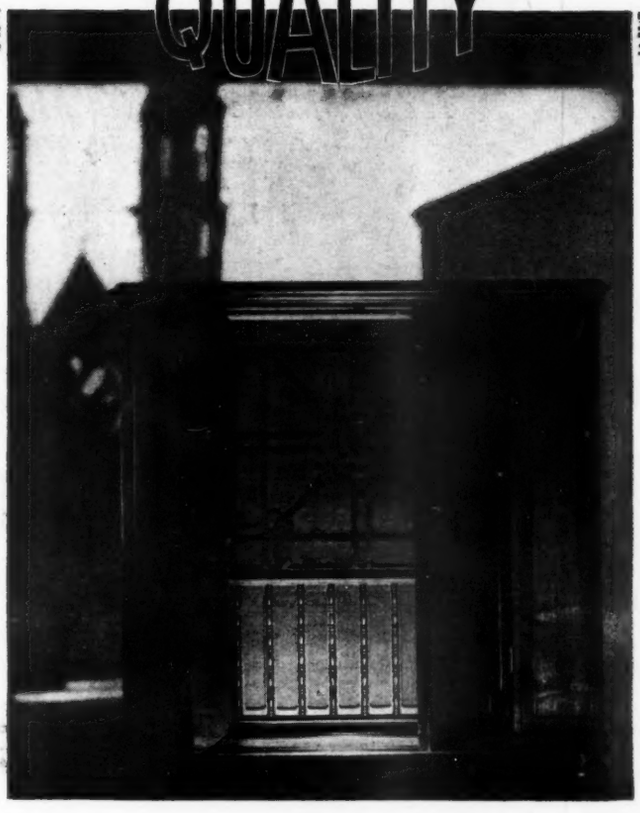
QUALITY

As rich in tone as a grand organ



Amplion Grand
AC15—$145

Walnut cabinet 34″ x 33″ x 18″ with fine piano finish and polychrome decoration.

A HAPPIER CHRISTMAS
for 2,500 families

EVERY AMPLION GRAND is a "laboratory model"—personally tested and approved by Amplion's Chief Research Engineer. Production is therefore necessarily limited. Only 2,500 can be built before Christmas.

The Amplion Grand combines those qualities to the highest degree which go to make up Amplion quality and world-wide prestige—beauty of tone and artistic appearance. Amplion's scientific efficiency in performance is especially appealing to readers of POPULAR SCIENCE

Other Amplion models from $12 to $97.50

Write for new Amplion booklet which illustrates and describes the full Amplion line.

THE AMPLION CORPORATION OF AMERICA
531 West 37th Street, New York
The Amplion Corporation of Canada Ltd., Toronto

Lion Cone
AC21—$25

A beautifully blended bronze finish cone, 14 inches in diameter, mounted on an 18-inch walnut sound board. Height 20½ inches, including bronze moiré base. New balanced armature unit with straight bar magnets of the finest grade English Tungsten steel.

Colonial Cone
AC12—$35

Handsome two-tone mahogany cabinet, 14″ x 14″ x 9″, with a fine piano finish. New Cone Assembly with Amplion balanced armature unit, straight bar magnets of finest English Tungsten steel.

AMPLION

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A Hint to Those with Pipe-Smokers on Christmas Lists

The following letter may prove to be a Christmas tip to those who have pipe-smokers on their Christmas lists:

Carney's Point, N. J.
January 7, 1927

Larus & Bro. Co.,
Richmond, Va.
Gentlemen:

My son noticed your advertisement in a magazine. He sent for the sample in my name, and when the sample of Edgeworth arrived I thought perhaps some friend had sent you my name.

The boy questioned me several times whether I liked the new pipe tobacco. When I told him I liked it better than any I had ever used, he surprised me by giving me a one-pound box for Christmas.

I might say that I do not hear any complaint from my wife any more about vile pipes.

Very truly yours,
James L. Vaughan

The two favorite gift sizes of Edgeworth are the 16-ounce glass humidor jar and the 8-ounce tin. Both are provided at Christmas time with appropriate wrappings. Each size contains Edgeworth Ready-Rubbed, and each is packed in a good-looking decorated gift carton printed in colors. Prices—$1.65 for the 16-ounce jar. The 8-ounce tins are 75¢ each.

Please ask your tobacco dealer for the Edgeworth Christmas packages. If he will not supply you, we gladly offer the following service to you:

Send us $1.65 for each 16-ounce jar, and 75¢ for each 8-ounce tin to be shipped; also a list of the names and addresses of those you wish to remember, with your personal greeting card for each friend.

We will gladly attend to sending the Christmas Edgeworth to your friends, all delivery charges prepaid.

Personal: Perhaps you yourself are not acquainted with Edgeworth. If so, send your name and address to Larus & Brother Company, 10 South 21st Street, Richmond, Va. We shall be glad to send you free samples—of Edgeworth Plug Slice and Edgeworth Ready-Rubbed.

Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors, holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

[*On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth Station. Wave length (254.1 meters) 1180 kilocycles*]

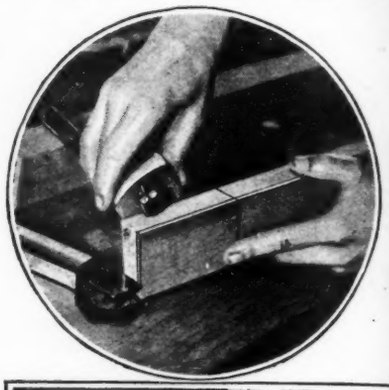
A Joint You Can Take Apart

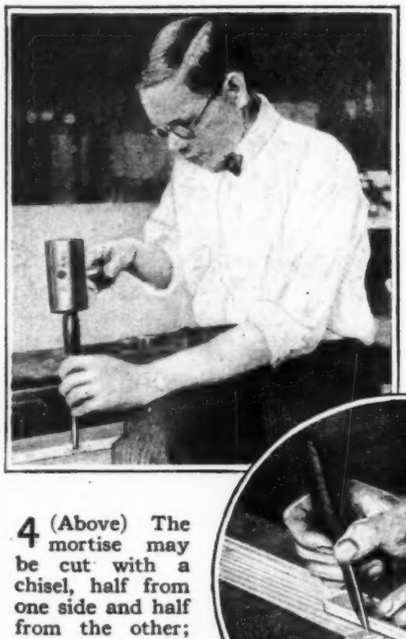
How to Make a Keyed Mortise and Tenon for Collapsible Furniture

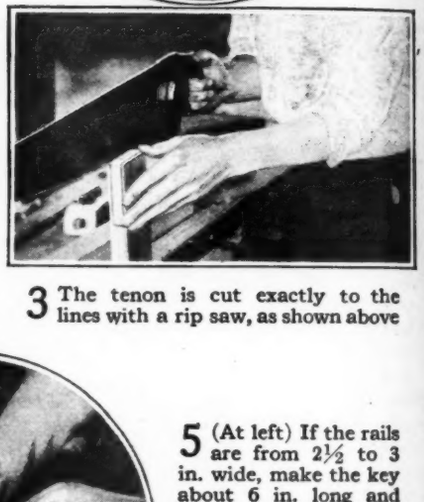
By Emanuel E. Ericson

1 When laying out the length of the tenon in the lighter types of construction, a good allowance will be from 1¾ to 2 in. If this is more than is needed, the tenon can be cut later

2 (Below) Lay out the thickness of the tenon with the marking gage, always keeping the head of the gage against the working face of the rail. Run lines also on the ends of the pieces to facilitate sawing. Next lay out and mark the mortises in the mating members with extreme care

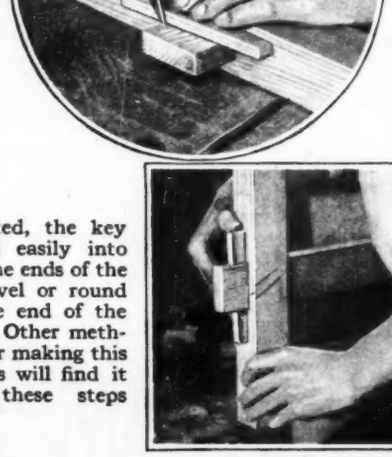






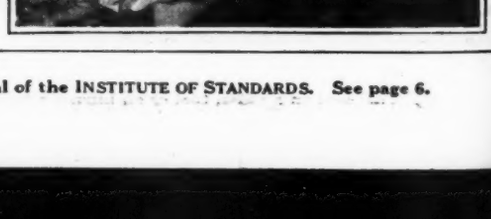
3 The tenon is cut exactly to the lines with a rip saw, as shown above

4 (Above) The mortise may be cut with a chisel, half from one side and half from the other; or an auger bit may be used and the holes trimmed up with a chisel



5 (At left) If the rails are from 2½ to 3 in. wide, make the key about 6 in. long and approximately half as thick as the tenon. It should taper in width from ⅝ to ⅞ in. Insert tenon through mortise, mark location of key as shown, and chisel a mortise for it

6 If properly fitted, the key can be pushed easily into place. Round off the ends of the key and either bevel or round the corners on the end of the protruding tenon. Other methods may be used for making this joint, but beginners will find it well to follow these steps



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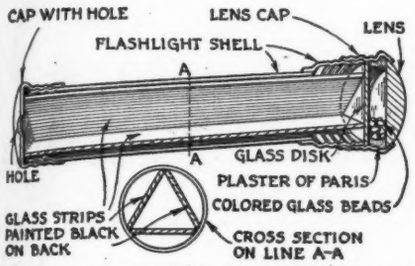
Kaleidoscope Made at Trifling Cost

AFTER vainly trying, in a city of half a million inhabitants, to purchase a kaleidoscope for my grandchildren, and failing even to get information as to how to construct one, I succeeded in making just what was wanted at the cost of a few cents. In years gone by the kaleidoscope was a familiar optical instrument or toy in which one could see reflected an endless variety of colored designs.

To make one, obtain a flashlight shell—one with a small hole at one end—and five cents worth of small colored glass beads at a ten-cent store.

Discard the reflector and the copper contact strip inside the flashlight shell,



Lengthwise section through the toy and cross section showing arrangement of reflectors

and remove the spiral spring that is fastened to the circular plate with a hole in it. After unscrewing the cap holding the lens, fasten the lens in the cap with plaster of Paris or some other cement. Then cut a circular disk of thin glass to fit in the cap over the lens.

Lay a single layer of the smallest and most highly colored beads upon the flat side of the lens, and place the glass disk over them. Now put the lens cap on the flashlight shell, but not so far as to interfere with the free movement of the beads. A drop of solder will hold the cap in place permanently

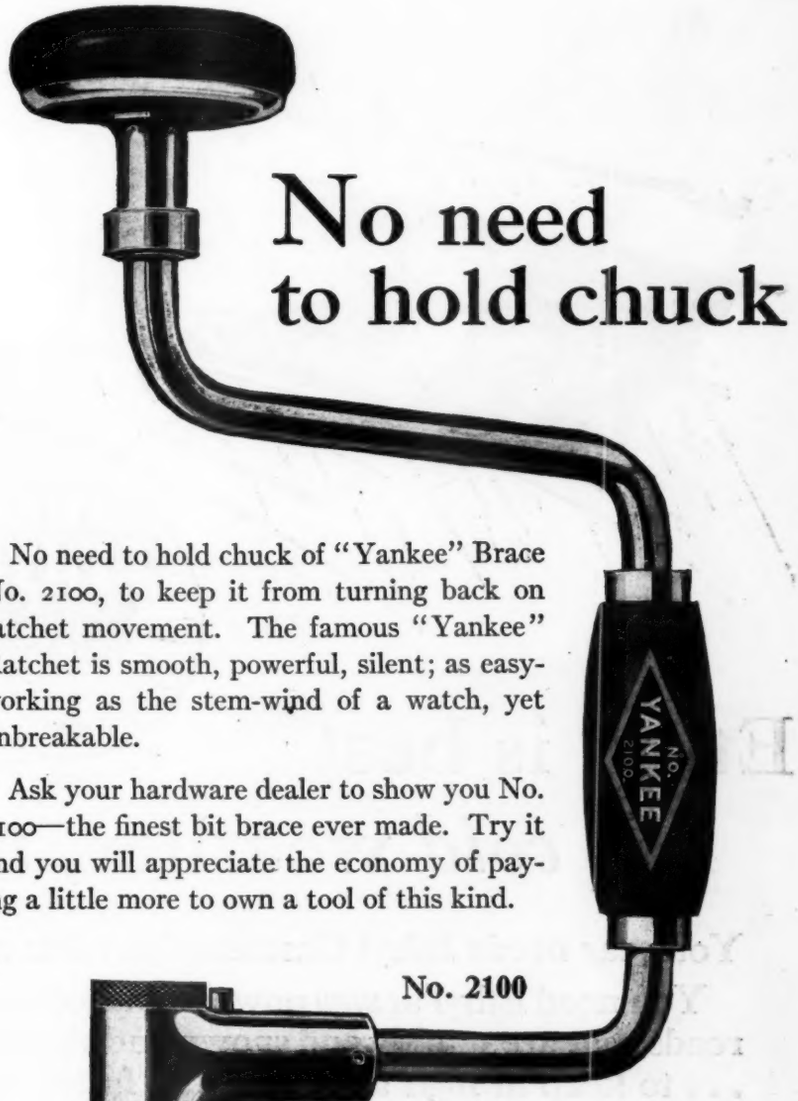
Cut three pieces of thin glass so that they will form an exact equilateral triangle, as shown, when they are inserted in the shell. Paint these black on one side and place them in the shell with the unpainted side facing inward. Screw on the cap with the black disk, which has the eyehole, and the kaleidoscope is made.—G. A. BAHN.

How to Stripe Furniture

AFTER a number of unsuccessful attempts to stripe various small articles about my house with brushing lacquer in a striping brush, I tried an ordinary draftsman's ruling pen. The results were excellent. I find, too, that compasses can be used equally well.

The only precaution necessary, is to have on hand for cleaning the pens a small amount of the thinner recommended for the particular brand of lacquer in use. Unless they are cleaned frequently, the pens will become clogged.

Using the pens in this manner does not harm them in the least.—CHAS. W. HAWTHORNE, JR.



No need to hold chuck

No need to hold chuck of "Yankee" Brace No. 2100, to keep it from turning back on ratchet movement. The famous "Yankee" Ratchet is smooth, powerful, silent; as easy-working as the stem-wind of a watch, yet unbreakable.

Ask your hardware dealer to show you No. 2100—the finest bit brace ever made. Try it and you will appreciate the economy of paying a little more to own a tool of this kind.

No. 2100

"YANKEE" Ratchet Shifter.—A finger-touch gives right or left ratchet, or rigid. Positive adjustment. Dust-proof. Moisture-proof.

New "YANKEE" Chuck.—Ball bearing. Quick centering and accurate. Won't loosen in work with any bit; round, square, taper, ½ in.

"YANKEE" Hard Rubber Handles. Unbreakable. Do not warp, shrink, crack or bind. Top handle steel-clad, ball bearing. Sweep handle caps held by patented "YANKEE" method, preventing excessive handle play.

"YANKEE" Finish.—Nickeled and finished in keeping with the perfection of its construction.

"Yankee" on the tool you buy means the utmost in quality, efficiency and durability.

Write for FREE "Yankee" Tool Book.

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" Christmas Suggestions

No. *1530* Ratchet Hand Drill
No. *1435* Two-Speed Hand Drill
No. *41* Automatic Push Drill
No. *1555* Ratchet Breast Drill
No. *90* or *95* Plain Screw-drivers
No. *1092* Vise with Swivel Base
No. *2100* Ratchet Bit Brace
No. *10* and *15* Ratchet Screw-drivers
No. *130-A* Spiral Screw-driver

Dealers Everywhere Sell "Yankee" Tools.

"YANKEE" TOOLS

Make Better Mechanics

ETHYL
BRAND OF
ANTI-KNOCK
COMPOUND
ETHYL GASOLINE
CORPORATION
NEW YORK, U.S.A.
Knocks out that "knock"

Ethyl is best for *cold* weather, *too*

Your car needs Ethyl Gasoline this winter.

You need Ethyl's *extra* power to negotiate roads that are muddy and snowy and slushy . . . to keep in high and get away faster in winter traffic . . . to reduce engine strain . . . and, most of all, to "knock out that 'knock'."

The ingredient in Ethyl Gasoline—tetra-ethyl lead—which made Ethyl the best summer fuel makes it best for cold weather too. *It's the superior high-compression fuel for all seasons.* And if you are driving one of the new high compression engines, Ethyl will give you a still greater thrill.

Ride with Ethyl the year round. This improved motor fuel is on sale at thousands of pumps throughout the United States and Canada which display the "ETHYL" emblem shown above. Fill your tank today.

ETHYL GASOLINE CORPORATION
25 Broadway, New York City

ETHYL GASOLINE

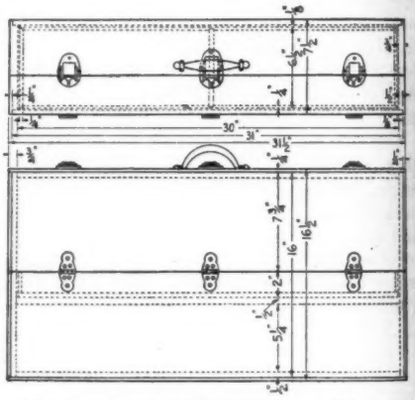
How to Make a Tool Case

By J. C. EDDIE

THE popularity of this type of tool case is sufficient proof of its many merits. Although used primarily by the carpenter, it is a fine case for the handy man with his informal set of tools. Its ease of portability makes it useful even to the mechanic who already possesses one or more large chests or cabinets.

Every handy man needs a convenient and portable tool case for odd jobs

The materials needed are: 1 pc. oak ¾ by 8 in. by 8 ft.; 2 pcs. oak (3-ply) ⅜ by 16 by 30 in.; 1 pc. white pine ⅜ by 6 in. by 6 ft.; 1 tool box lock, 2 tool box clasps, 8 box corners, 3 hinges, 1 leather sample case handle; 42 No. 5-½-in. screws, round head; 40 No. 6-1-in. screws, round head; 28 No. 6-1¼-in. screws, round head; 2 doz. ⅛ by 1 in. machine screws; 1 package twopenny brads. All hardware should be of solid brass.



Front and top views of the case and, at the right, the end view. Oak is the wood used

Cut the 16 in. long end pieces from the ¾ by 8 in. piece of oak and the 31½ in. long top and bottom pieces from the same stock. Rabbet the ends of the top and bottom ⅜ by ¾ in. as shown for the joints. Mark the end pieces and the top for the door and saw out with fine saws very carefully. Plane down the other pieces to make up for the saw kerf. *(Continued on page 99)*

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Hello boys!

Send for this free book which tells all about my NEW 1927 ERECTOR

with these sensational new features

1—Complete Unit Control (New assembled Trumodel Construction equipment parts)
2—New Erector Trumodel 3 Drum Hoist
3—New Erector Trumodel Tip Bucket
4—New Erector Trumodel Clam Shell Bucket
5—A great assortment of New Feature Parts
6—Erector *Complete Unit* Accessory Sets
7—Udylite — the rust-proof finish (some parts)
8—The new Brass Perfect Gear standardization

Wonderful new No 7½ ERECTOR $15.00

With Automobile Chassis

Here's the set I know will give you the greatest thrill you ever had. Fun! Oh, Boy! It's the real thing, and there's a thrill packed in every one of its 627 parts. Boys, in this great outfit there are hours of real sport waiting for you building automotive models. From this great assortment of distinctive, important and feature Erector parts you can build 554 models—wonderful automobile chassis, tractors, scooters, service cars, fire engines, hook and ladder, are only a few.

Packed in a cabinet and includes a complete assortment of automotive parts, many in colors; also a 92-page manual, powerful electric motor, big red steel disc wheels with oversize balloon tires, fenders, radiator hood, bumper, springs, steering wheel, truck body, heavy truck axles, cab top, boiler, digger scoop—in fact, everything to make this set a world's standard.

Why the New ERECTOR *is the world's greatest toy*

Trumodel Features:

1 ERECTOR SQUARE GIRDER. This big, exclusive Erector feature makes Erector so sturdy and strong. They are real girders just like engineers use in making skyscrapers and bridges. (In all Erector Sets.)

2 ERECTOR MOTOR. You can make 27 interesting experiments with the Erector Motor alone. The motor Shaft is the same diameter as all other shafts. You can hitch pulleys to both sides of the motor. (In the Famous No. 4 Erector and up.)

3 3-DRUM HOIST. Completely assembled operating unit. New exclusive Erector feature. (In the No. 8 Erector and up.)

4 TIP BUCKET. An exclusive Erector feature. (In the No. 8 and up.)

5 ERECTOR STEAM BOILER. There is no end to the models that this exclusive Erector feature makes possible. Hoisting engine, steamboats, fire engine, horizontal engine, locomotives. The Erector motor furnishes power to make these models go. (In the Super No. 7 and up.)

OTHER COMPLETE UNIT CONTROL PARTS MOTORIZED FEATURES, ARE:

Large solid steel disc wheels with balloon tires, chassis, genuine fenders, hood, bumper, truck body, steering wheel, steering knuckle, front axle, springs. (All in the No. 7½ Erector and up.)

Other Erector Features

1. Erector contains more parts and builds more models than any other construction toy.
2. The New Erector Steam Shovel—an exclusive Erector feature. (In Super Erector No. 7 and up.)
3. The New Erector Dredge Bucket—an exclusive Erector feature. (In the New No. 10.)
4. Curved Erector Girders. An exclusive Erector feature. (In all sets.)
5. Giant Fly Wheel. An exclusive Erector feature. In the No. 10 Set.
6. Perforated Strips—four holes to the inch.
7. New brass perfect gear standardization. The New Erector contains a great assortment of brass and die-cast gears, including pinion, crown gears, flat gears, mitre gears, and a large 72-tooth gear.

A FEW OF THE MANY NEW 1927 FEATURE PARTS ARE:

Boiler plate, bull ring, new Chain Bucket, Beam Girders Curved, Segment Plate, Ratchet—and hundreds of other genuine perfect mechanical parts for duplicating every engineering feat ever attempted. Possible with no other toy than the New Erector.

1. Erector is made from structural steel, plated enameled and electrically baked.
2. Designed by engineers, used by engineers and endorsed by engineers.
3. The Mechanical features of Erector are correct. It is the only correct method of reproducing engineering feats.
4. Perfectly interchangeable, owing to the minute details of standardization.

Boys! Here's the greatest book I ever compiled

In this book you will find the final story of my years of experience since I first invented Erector—the construction set which other engineers have been kind enough to call "the world's greatest toy"—and which they consider one of the most astonishing mechanical phenomena of the age.

In this book I tell you how with Erector's new Construction parts you can build and operate (one after the other) over 1000 actual working models of Aeroplanes, Submarines, Ocean liners, Light houses, Machine guns, Automobiles, Ship cranes, Trains, Steam shovels, Traveling crane, Wrecking hoist, Trench diggers, Locomotives, Hoisting derricks, Cantilever bridges, Suspension bridges, Well drillers, Power plants and Hoisting engines.

Think what a thrill you'll get making these wonderful working models whiz and hum with the powerful Erector electric motor. The day you get your Erector (Christmas or any other day) will be the biggest of your life. Send for my new book "Engineering Thrills" today and then tell your Dad. Don't miss this chance. Make him realize what you really want by showing him the book and then taking him to the nearest toy store to see for himself. He'll want to build models with Erector too. Just fill out the coupon below.

A. C. Gilbert

Send for it—FREE

THE A. C. GILBERT COMPANY,
209 Blatchley Avenue, New Haven, Conn.

Please send me free my copy of the book "ENGINEERING THRILLS."

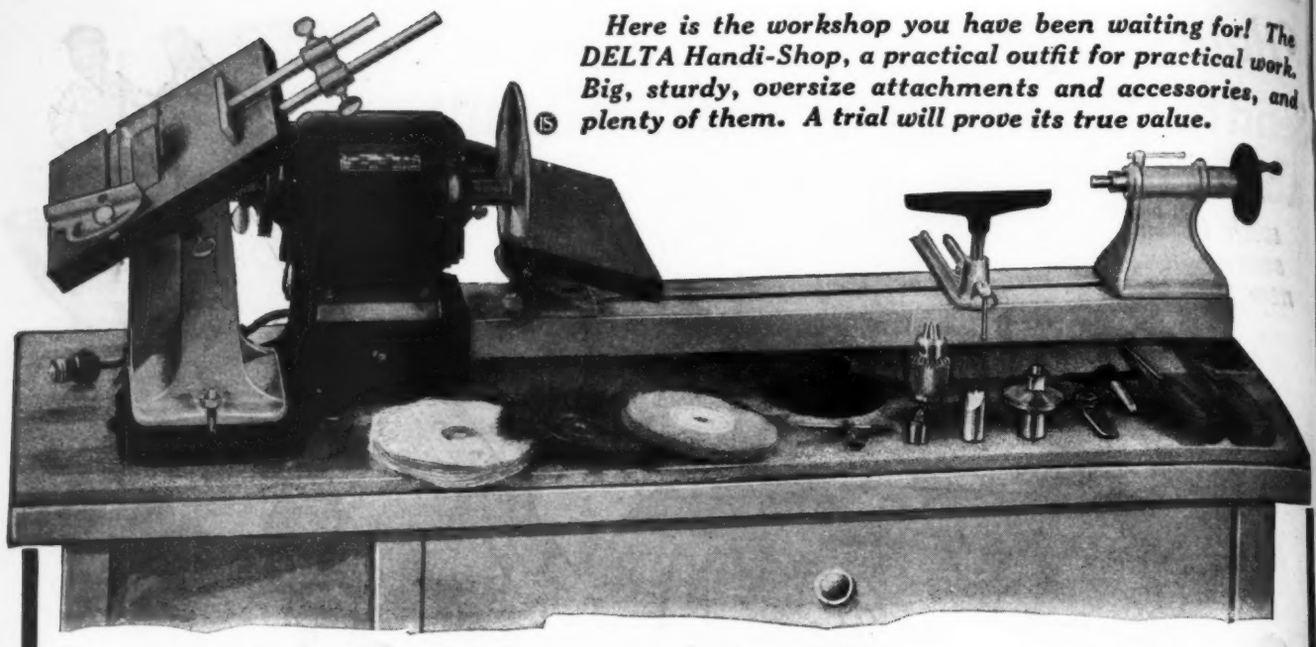
Name .....

Street .....

City ..... *State* .....

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Here is the workshop you have been waiting for! The DELTA Handi-Shop, a practical outfit for practical work. Big, sturdy, oversize attachments and accessories, and plenty of them. A trial will prove its true value.



Different ? SURE !- Here's Why-

Delta Handi-Shop

Make these beautiful things, and thousands of others, there is practically no limit to the work the DELTA will do.

WE SET out to produce a really practical and efficient work shop. After long and careful study and experimenting, we scrapped all of the old, conventional designs and ideas, and decided upon using a sturdy, quiet-running motor of special design, *with two shaft extensions*—right there we had a valuable feature that offered unusual, and practically unlimited, possibilities.

While the much-used Circular Saw is driven from one shaft, the Lathe, with its many attachments, can be driven from the other shaft. There are always two tools ready for work and easily controlled by a conveniently placed switch. Simply throw off the Special Rubber V-belt and the saw is disconnected. In a jiffy any one of the many *full-sized*, sturdy, practical accessories is in place and you are ready to go. Simple, isn't it? You never saw anything so easy—so quick—so convenient as the interchanging of attachments. You must try it to thoroughly appreciate its many advantages—its outstanding superiority.

The Delta Handi-Shop consists of the following—all specially designed—all sturdily built from the finest materials obtainable.

Motor—Specially designed ¼ H.P. fully enclosed, 1750 R.P.M., constant speed, **with two shafts.**

Lathe—has capacity of 9" diameter x 24". (Can be furnished up to 36" at small additional cost.) Steel bed of 4" U-Section—will not chatter or spring. Ballbearing Tailstock, 4" face plate, spur center, cup center, and wide and narrow tool supports.

Lathe Attachments—6" diameter, fast-cutting emery wheel, adapter flange, 6" buffer, 5" wire brush, all of finest quality—all oversize. ⅜" capacity Jacobs chuck that fits both motor and tailstock spindles; two turning tools.

Sanding Attachment—8½" diameter "Man Size" sanding disc. Takes standard sheet of sand paper. Novel design sanding table 5"x12", tilts 45° down, 10° up. An exceptionally valuable and useful attachment, quickly attached and easily adjusted.

Flexible Shaft—Can be furnished in two sizes, with hand pieces to take standard burrs. Ideal for carving, metal pattern and die work, etc.

Now—Give Yourself a Treat!

Make all those wonderful attractive things you want around the house. Develop your ideas and inventions. Get started in business—earn money on full or spare time. Let the DELTA HANDI-SHOP be your never-failing and faithful servant. Lack of space does not permit a full description here so act now—send for it and judge for yourself.

10 Days FREE Trial

A small down payment brings this **complete** workshop to you. Use it. Do those unusual things that only Delta Handi-Shop can do. You can do the simple things easier and quicker, too. Let us send you our beautiful, illustrated folder that describes in detail every novel and original feature of the DELTA HANDI-SHOP. See how much you get for so modest an outlay of money.

Mail Coupon *NOW*

FREE BLUE PRINTS

Delta Specialty Co.
Dept. MSP.—1227—858 3rd St.,
Milwaukee, Wis.

Send me your illustrated color folder describing Delta Handi-Shop. Tell me about your Free Trial offer, free blue prints and easy payment plan.

Name.....

Street Address.....

City.....State.....

Dept. MSP

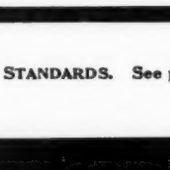
The famous New Model "American Giant" Scroll Saw, 12" throat, cuts up to 1½" thick. (Patented August 21, 1923.) Table tilts 45° to left, 15° to right. Can be furnished with jewelers frame. Saw blade supported underneath table, an exclusive Delta feature.

Cutting a 1"x12" board at an angle. No interference, floor and ceiling are only limits to length of board handled.

Cutting groove with dado head, either straight or at an angle, with table raised for depth of cut. It's easy with the Delta Handi-Shop.

Sanding proper draft on pattern, and siding and squaring electrotype—two of the many possible operations with this attachment.

Showing special frame for holding real fine jeweler's blade for delicate marquetry, jeweler's or inlay work. Takes standard 5" long jeweler's blades. Note table is tilted fully 45° to the left. Blade always securely supported by hardened guide underneath table.



Showing small flexible shaft attachment. Note the delicate work possible. Uses standard burrs, easily obtainable everywhere.

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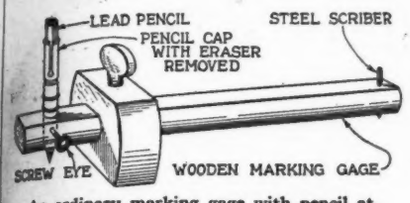
Pencil Holder Improves Marking Gage

FOR use in the home shop, an inexpensive marking gage may be improved by mounting a lead pencil at one end of the bar as shown. The pencil does not follow the grain of the wood when running parallel with it, as the steel point is apt to do, and the line is easier to see.

The holder is a long metal cap or point protector such as is sold with some pencils.



An ordinary marking gage with pencil attachment makes lines that are easy to see

The eraser is removed and the tube is pushed into a hole bored through the gage bar.

A gage modified in this way is particularly useful in ship-model work and many other small woodworking operations, as well as for marking large boards which are to be rip-sawed into narrow widths.—E. T.

How to Make a Tool Case

(*Continued from page 96*)

Rabbet the long edges of the top, bottom and end pieces ⅜ by ⅜ in. to receive the ⅜ in. thick side panels flush. Glue up the top, bottom and end pieces and use three screws from both directions, being sure that the case is square. Square one side and the end of the side panels and cut them to size; then glue and screw them in place. One side, of course, will have to be cut out for the door.

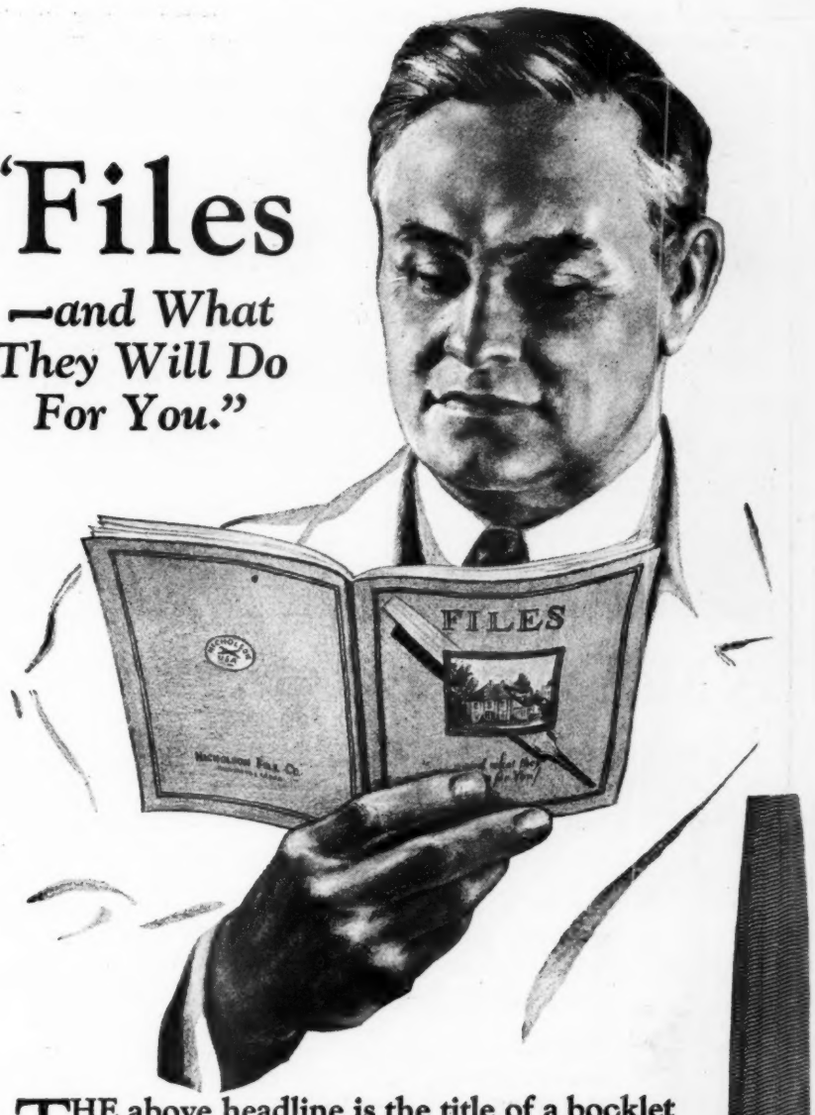
Perhaps it will be best to leave the tray to the ideas and needs of the individual, but it is made to rest on cleats placed on the ends and at the middle of the box so that its upper edge will be flush with the joint of the door. It should be a little narrower than the inside measurements of the box to allow room for the steel square, which will be kept in the back of the box.

Cleats should be arranged in the door to carry the saws. Hooks and other cleats can be installed for holding other tools.

Stain or merely oil the case with pure boiled linseed oil, as preferred. When the wood is dry, use two coats of shellac, rubbing each down with fine sandpaper. Follow with two coats of varnish (on the outside only); rub the first with fine sandpaper and leave the second as applied or rub it with fine powdered pumice and oil, according to whether a dull or glossy finish is desired. For a finish that can be applied more quickly, use stain, one coat of thin shellac, and two coats of high grade, clear brushing lacquer.

Mark the location of the hardware. Use the ½-in. round-headed screws for the hinges and corner clips and the ⅛ by 1 in. brass machine screws for the locks, snaps and handle. Rivet the inside ends to make it impossible to open the box merely by turning out the screws.

"Files —and What They Will Do For You."



THE above headline is the title of a booklet whose contents have helped thousands to make practical home repairs.

The reader gets a new slant altogether on what can be done with files. He learns how to sharpen edged tools of every kind; make a stubborn lock turn easily; put new life into dying electrical contacts; repair a radio; clean a soldering iron; fix an obstinate bureau drawer.

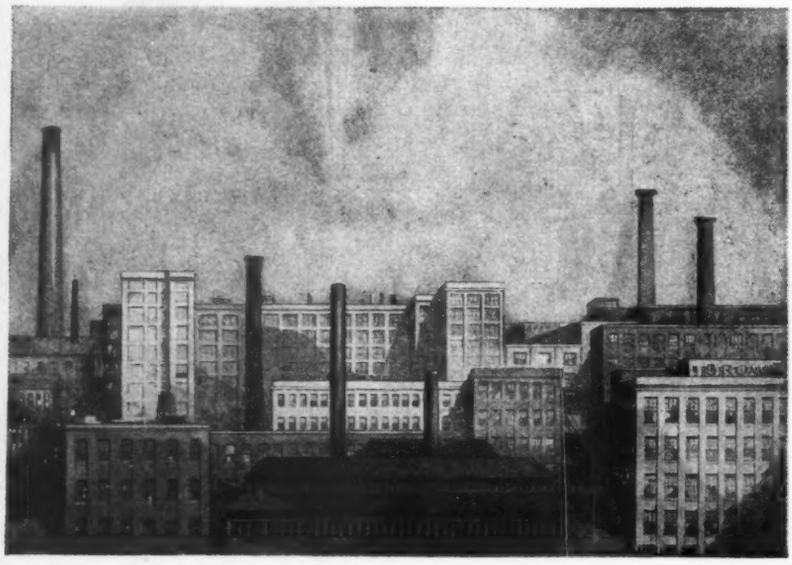
In short, "Files and What They Will Do For You" is a readable little text book on the art of working about the home. We've never computed its cash value because its always sent free on request.

We think that after reading "Files and What They Will Do For You" you will want some NICHOLSON Files. Your hardware dealer can supply you.

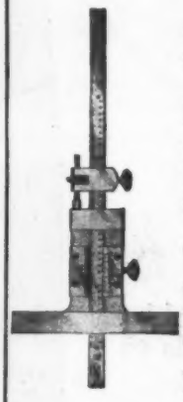
NICHOLSON U.S.A. (TRADE MARK)

NICHOLSON FILE CO.
Providence, R. I., U. S. A.

—A File for Every Purpose



A Mechanical World In Itself



THOSE who go through the Brown & Sharpe plant very frequently come out with the impression of having visited a mechanical world in itself.

Every facility exists in this plant for making Brown & Sharpe precision tools with almost unbelievable accuracy and for testing them with painstaking care.

This work is done so well that the performance of Brown & Sharpe tools is recognized as setting a standard of accuracy by mechanics in shops all over the world.

Hardware dealers everywhere carry Brown & Sharpe tools. If, by chance, your dealer does not happen to have a copy of our catalog, we will send you one free on request.

DEPT. P. S.
BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

B·S

BROWN & SHARPE TOOLS

"World's Standard of Accuracy"

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

LIGHT motor oil, or the lubricating oil sold as machine oil, has many uses in the home workshop. It can be used not only for lubricating machinery but also for polishing woodwork and protecting iron from rust.

To use the oil as a furniture polish for varnished and shellacked surfaces, first dust the surfaces with a soft brush or a piece of soft cloth. Then place a few drops of the oil on a clean rag and rub until the desired luster has appeared.

Machine oils of this kind may be diluted for polishing purposes with eight or ten times its volume of kerosene or gasoline. When gasoline is used, the mixture is, of course, highly inflammable and must be treated with respect. All open flames must be extinguished when the mixture is to be used. The effect of the diluting agent is to prevent an excess of oil being applied, which reduces the labor and also the likelihood of the surface being left so oily they will collect dust.

This oil polish should be well rubbed into the surface and any excess must be removed, preferably with a clean, soft rag. Then the wood can be further rubbed to bring out the finish.

While the recommendation is often made that the oil be applied on a damp cloth, I prefer to use a dry rag for polishing. If the rag is moist, one never knows when sufficient oil has been used. A surface to which the oil is applied with a wet rag will have a higher polish while the surface is covered with a film of water than when the film of water has evaporated. Quicker results are obtained by using a dry rag moistened with oil and then rubbing with another dry rag to remove any excess of oil.

WHEN the wood is dirty, the varnished and shellacked surface may be wiped with a cloth wrung in warm, slightly soapy water. The soap used should be a very mild one, such as castile. Wipe the finish dry at once and then polish with the oil.

If, after being cleaned, the surface appears badly worn, the varnish may be improved by rubbing it with floor wax.

Applying thinned light motor oil to iron or steel parts prevents rusting.

When oil is moist or contains water, the water may be easily removed by filtering the oil through salt. Take a large funnel, add the usual piece of filter paper, and half fill the filter paper with ordinary table salt. Pour the moist or watery oil on the salt; the dehydrated oil will flow out at the bottom, while the salt will hold the moisture. Running the oil through salt once is usually sufficient.

To remove a rusted screw, place a drop of oil on the screw and apply a hot soldering iron to the head. Add more oil and repeat the process if necessary.

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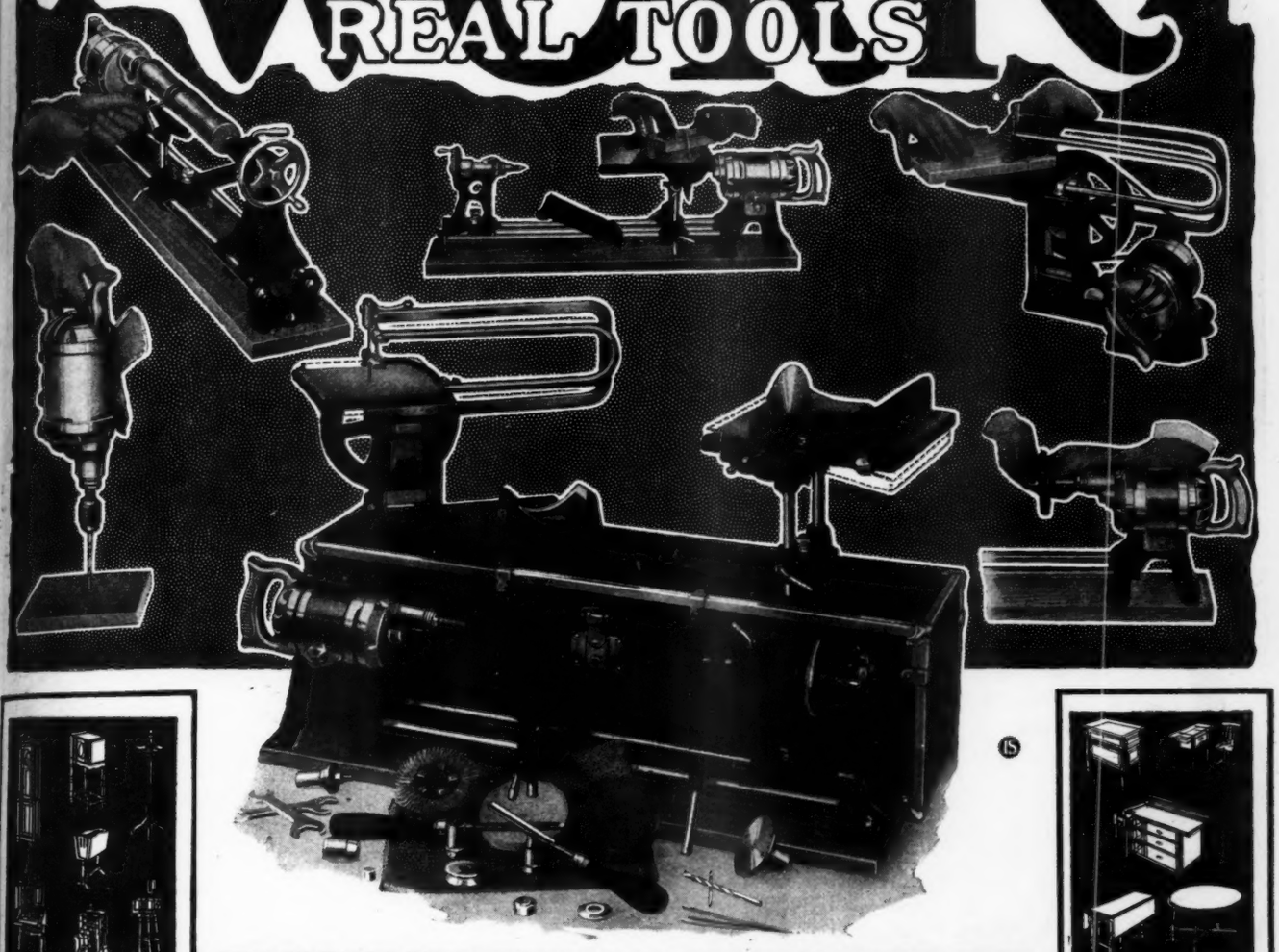
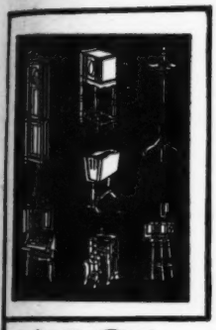
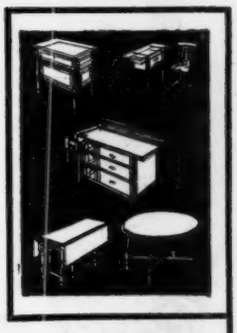
WITH THAT DEGREE OF ACCURACY ASSURED BY REAL TOOLS







HOME MECHANICS MADE EASY WITH THE NEW UP-TO-DATE HOME-CRAFTSMAN SHOP

ONLY $10 DOWN

AN ADVANCED DEVELOPMENT IN HOME CRAFTSMAN SHOP EQUIPMENT

The Up-to-Date electrical Home-Craftsman Shop can be used in any home lighting fixture, thus making of your old fashioned work bench a complete machine shop. The shop complete is made up of a Superpower motor, an accurate lathe (10x34 inches) which features the bevel, a miter, side and depth gauges, a superior tilting table, jigsaw, and all accessories for buffing, grinding, cleaning and all portable or stationary drilling and sawing. This collection of electrically driven tools which is complete in every detail, will make you an advanced craftsman. Master mechanics have designed and skilled engineers have constructed this equipment which, after inspection, you will agree is the best of its kind. For those who build, invent, create and construct at home, it is unexcelled.

SENT ON TRIAL

YOUR own terms on purchase. $10.00 down — balance arranged to your convenience. Liberal discount for cash.

Our Literature Gives All Details

THE UP-TO-DATE GUARANTEE

After receipt of the Up-to-Date Home-Craftsman's Shop if you are not satisfied, without question or delay every cent refunded and return express charges paid.

OUR EDUCATIONAL DEPARTMENT

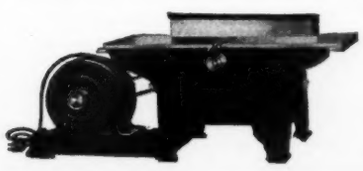
Under Personal Supervision of Master Craftsman Eugene E. Maurey offers special correspondence crafts course, giving in simple detail full information on home handicraft. Blue print service included in this course FREE to our users.

15″ Band Saw
Accessory to Up-to-Date Shop

CAREFULLY DESIGNED BLUE PRINTS FREE TO SHOP OWNERS

Working blue prints of furniture and other items which are useful about the home and shop. Hundreds free to shop owners.

4″ Jointer Model A-1928
Accessory to Up-to-Date Shop



NOT A TOY, A REAL MACHINE

10 DAY FREE TRIAL

Use our shop for 10 days at our expense, if not satisfied—Return—express collect.

MAIL THIS

For Full Particulars to

UP-TO-DATE MACHINE WORKS
2915 South Wabash Ave., Chicago, Ill.

MANAGER, Dept C:—Without any obligation please send me full particulars about your shop, 10 day free trial, free blue prints, free crafts course. Also $10.00 down payment offer.

NAME.....

ADDRESS.....

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Ranks High!

New Model

Pocket Ben

The New Model Pocket Ben ranks high among good watches. That's because it combines good looks with correct time-keeping.

Sold everywhere for $1.50. With night-and-day dial $2.25.

Built by the makers of Big Ben and other Westclox.

WESTERN CLOCK COMPANY
La Salle, Illinois

Blueprints for Your Home Workshop

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....dollars.....cents:

No.	Title	Described in Issues of		Price
1.	Sewing Table	Feb.,	'22	25c
2.	Smoking Cabinet	Mar.,	'22	25c
3.	End Table	Apr.,	'22	25c
5.	Kitchen Cabinet	May,	'22	25c
8.	Shaving Cabinet	June,	'22	25c
9.	Arbor, Gate and Seats	July,	'22	25c
10.	Porch Swing	Aug.,	'22	25c
11.	Bench and Tilt Table	Sept.,	'22	25c
12.	Electric Washer	Oct.,	'22	25c
13.	Tea Wagon	Nov.,	'22	25c
14.	Christmas Toys	Dec.,	'22	25c
15.	Workshop Bench	Jan.,	'23	25c
16.	Inlaid Radio Cabinet	Feb.,	'23	25c
17.	Cedar Chest	Mar.,	'23	25c
18.	Phone Table and Stool	Mar.,	'23	25c
19.	Grandfather's Clock	Apr.,	'23	25c
20.	Flat Top Desk	Apr.,	'23	25c
21.	Colonial Desk	Apr.,	'23	25c
22.	Cabinet and Desk	Apr.,	'23	25c
23.	Pergola Garage	May,	'23	25c
24.	Gateleg Table	June,	'23	25c
25.	Canoe Sailing Outfit	July,	'23	25c
26.	Baby's Crib and Pen	Sept.,	'23	25c
27.	Kitchen-Cabinet Table	Oct.,	'23	25c
28.	Pullman Play Table	Nov.,	'23	25c
29.	Toy Tea Cart, etc.	Dec.,	'23	25c
30.	Tool Cabinet, etc.	Jan.,	'24	25c
31.	Sewing Cabinets	Feb.,	'24	25c
32.	Chinese Game Table	Mar.,	'24	25c
33.	Dining Alcove	Apr.,	'24	25c
34.	Garden Trellises	May,	'24	25c
35.	Simple Radio Cabinet	Oct.,	'24	25c
36.	Rush-Bottom Chair	Nov.,	'24	25c
37.	Simplified Bookcase	Dec.,	'24	25c
38.	Sheraton Table	Jan.,	'25	25c
39.	Salem Chest	Feb.,	'25	25c
40.	Desk in Sheraton Style	Mar.,	'25	25c
41.	One-Tube Radio Set	May,	'25	25c
42.	Three-Stage Amplifier	June,	'25	25c
43.	Four-Tube Receiver	July,	'25	25c
44.	Pirate Ship Model—Hull	Feb.,	'26	25c
45.	Pirate Ship—Details	Mar.,	'26	25c
46.	Galleon Model—Hull	May,	'26	25c
47.	Galleon Model—Details	June,	'26	25c
48.	Sailing Yacht Model	July,	'26	25c
49.	Broom Cabinet	Aug.,	'26	25c
50.	Airplane Model (Flying)	Sept.,	'26	25c
51.	Clipper Ship Model—Hull	Oct.,	'26	25c
52.	Clipper Model—Details	Oct.,	'26	25c
53.	Clipper Model—Rigging	Nov.,	'26	25c
54.	Five-Tube Radio Set	Oct.,	'26	25c
55.	Five-Tube Set—Details	Oct.,	'26	25c
56.	Bird and Animal Toys	Dec.,	'26	25c
57.	*Constitution* Model—Hull	Jan.,	'27	25c
58.	*Constitution*—Rigging	Feb.,	'27	25c
59.	*Constitution*—Rigging	Mar.,	'27	25c
60.	Welsh Dresser	Mar.,	'27	25c
61.	Viking Ship Model—Hull	Apr.,	'27	25c
62.	Viking Ship—Details	Apr.,	'27	25c
63.	Toy Motor Boat—Hull	May,	'27	25c
64.	Toy Motor Boat—Details	May,	'27	25c
65.	Six Simple Block Puzzles	June,	'27	25c
66.	Ship-Model Weather Vane	Aug.,	'27	25c
67.	Toy Model of Lindbergh's New York-to-Paris Plane	Aug.,	'27	25c
68.	Magazine-Rack Table and Book-Trough Table	Sept.,	'27	25c
69.	Flying Model (3 ft.) of Lindbergh's Monoplane	Oct.,	'27	25c
70.	Console Radio Cabinet	Nov.,	'27	25c
71.	Console Cabinet—Details	Nov.,	'27	25c
72.	Doll's House	Dec.,	'27	25c
73.	Doll's House Furniture	Dec.,	'27	25c
74.	*Santa Maria* Model—Hull	Dec.,	'27	25c
75.	*Santa Maria*—Rigging	Dec.,	'27	25c
76.	*Santa Maria*—Details	Dec.,	'27	25c

Name .....
(Please print name and address very clearly)

Street .....

City and State .....

WHAT makes you think that you can't earn many hundreds of extra dollars yearly playing a King Band Instrument? You like music! You envy the person who plays well. Then make up your mind that you, too, will learn.

For more than a quarter-century we've helped young people achieve great success in music. Let us show you the easy way to greater popularity and profits.

But, first investigate our claim that any person will learn to play quicker with a King. These perfect Instruments of the Masters are sold on terms as easy as those offered by makers of the cheaply built kind.

Mail the coupon below and we'll send you booklets that may prove the beginning of the happiest days of your life. Don't delay!

KING THE H. N. WHITE CO.
5237-94 Superior Ave., Cleveland, O.

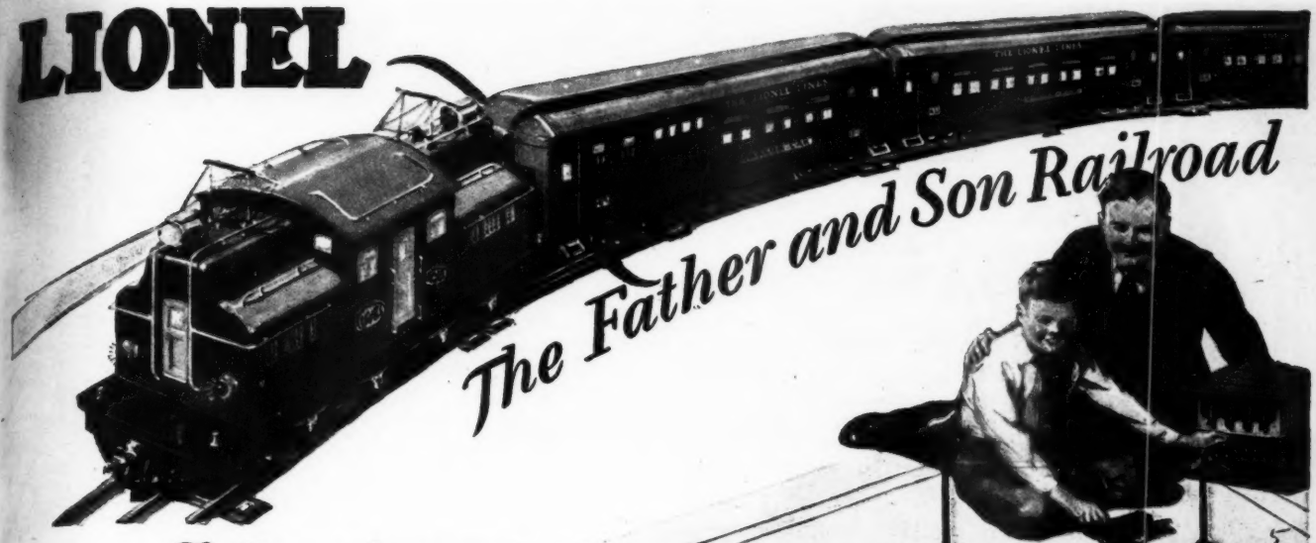
Please send me free copy of The "White Way" and your Handy Reference Catalog. (Check, below, instrument preferred.)

Name.....Age.....
Address.....
City.....State.....
☐ Saxophone ☐ Trumpet ☐ Trombone ☐ Alto
☐ French Horn ☐ Baritone ☐ Bass ☐ Bugle

The nation's strength is the nation's health. Buy Christmas Seals and help preserve it.

THE NATIONAL, STATE, AND LOCAL TUBERCULOSIS ASSOCIATIONS OF THE UNITED STATES

LIONEL



The Father and Son Railroad

For Boys who want to be men, and men who want to be boys

IF you could take a great railroad system that runs across the Continent and transform it into a miniature size for your home—you would have Lionel, the most realistic electric railroad in the world! It is 100% Electrically Controlled—it is so real—it operates as if by magic.

Imagine yourself on Christmas morning, the gleaming tracks all laid out—the wiring all hooked up, illuminated station in its place, lamp posts shining brightly, everything set. And there waiting to go is the beautiful Lionel Super-Motor Locomotive, ready to thunder down the rails with its Pullmans, Diner, or as many of the twenty-nine different Lionel Freight Cars as you choose.

You're sitting at the switch tower, your hand at the controls. Touch a lever and presto!—the train comes to life, speeds up and whizzes away! Watch her as she passes the crossing gates, which automatically raise and lower—there she glides through the illuminated tunnel—then takes the turn and approaches that marvelous new Lionel Train Control Semaphore. The red light's on—arm is down—the train halts automatically—then as the arm raises and the green light flashes your train once more is on its way! Now there's a switch ahead—back in the switch tower you touch a lever and the track switch is thrown—and your train whisks into a sliding! And remember, you can stop it and back it out onto the main road again by manipulating the levers in the switch tower. Always—you can control your Lionel Train at any distance down the track.

What fun! Play a thousand games—dream a thousand dreams with a Lionel Railroad. There are so many astounding features—the new Lionel Derrick Car, for example, which has operating boom and tackle! Amazingly real! You have to see it operate to believe it!

Lionel All-Steel Tunnel No. 120L Illuminated

Lionel Electric Bell-Signal Nos. 069 and 69

Lionel Switch Tower No. 437

Lionel Electrically Controlled Switch Nos. 222 and 012

Lionel Operating Derrick Car No. 219

Lionel Power House Nos. 435 and 436

Lionel Operating Dump Car No. 218

Lionel Train-Control-Semaphore Nos. 82 and 082

Free!

Send for our free Model Railroad Planning Book

See for yourself just how wonderful the Lionel Railroad System really is! Our book is the most elaborate ever published. In full colors it shows the great variety of Lionel Trains and Equipment. It describes the Lionel 100% Electrically Controlled Railroads for "0" Gauge and "Lionel Standard" Track. This great 46-page book shows the supreme quality and built-in excellence of all Lionel Products. Sets from $5.75 to $300. Send for the book today.

See Lionel Products demonstrated at the leading department stores, toy, hardware, electrical, sporting goods and furniture stores

THE LIONEL CORPORATION, Dept. F., 15-19 EAST 26TH ST., NEW YORK, N.Y.

"STANDARD OF THE WORLD SINCE 1900"

LIONEL ELECTRIC TRAINS

MODEL RAILROAD ACCESSORIES

"MULTIVOLT" TRANSFORMERS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

STAR HACKSAWS

have swept the Industrial sky because over Forty years of intensified production and the best in materials and workmanship qualify them to excel.

Built to Stand the Strain

STAR HACK SAW BLADES have proved their superior qualities by trial under the most rigorous conditions.

STAR HACK SAW BLADES are Universally acknowledged the *Best* and have won this distinction thru sheer merit. The solution to hard cutting jobs rests with STAR HACK SAW BLADES. They are the only choice of metal workers who KNOW.

Clemson Brothers, Inc.
Middletown, N. Y.

MAKERS SINCE 1883

Ⓢ

STAR HACK SAWS

A Doll's House

(*Continued from page 75*)

board (No. 3) serves both as floor and ceiling, it is sandpapered on both sides.

The rooms will be so small when the house is assembled that it will be next to impossible to do much nailing or other work within them. For this reason it will be best to do all the fitting of doors, bases, casings, stairs and the like before the house is completed. The three sections shown in Fig. 3 should each be assembled as separate units. Do all wall painting

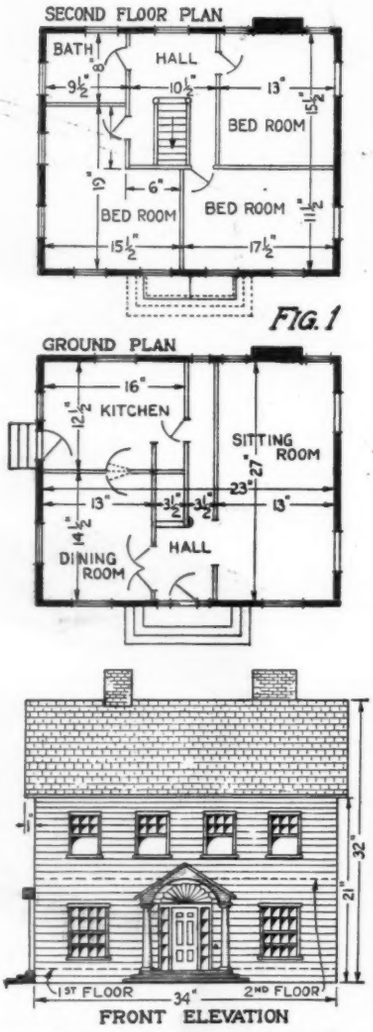


FIG. 1

How closely the model resembles a real house is shown by the plans and front view

or decorating and floor polishing while the sections are still open.

Next, the outside walls should be made up. The door and window openings should be marked out accurately on both sides of the board and cut out with an ordinary coping saw or keyhole saw.

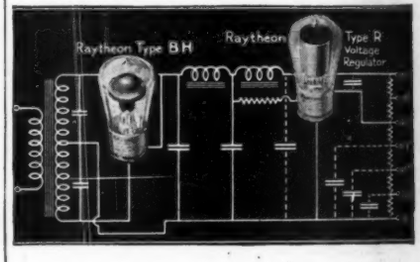
For casing and finishing the doors and windows see Figs. 5 and 6. The casings may be made of ⅛-in. wood. The cheap yardsticks that some firms use as advertising mediums, if planed smooth and ripped through the center, are just the thing for this purpose. If these cannot be found, heavy cardboard or berry crates will serve quite well. If the casings are

(*Continued on page 106*)

Ⓢ

Raytheon Type R Voltage Regulator

For improvement in both the construction and performance of light-socket power units here is the tube to use! When incorporated in the proper circuit, Type R maintains constant voltage on the 90 and lower volt taps and greatly improves regulation on the 180 and 135 volt taps *regardless of changes in line voltage or load current.*



Send for this Diagram

The Raytheon Research Laboratories will gladly furnish you with power unit plans which use Raytheon Type BH 125 m.a. rectifying tube and Type R Voltage Regulator tube to their best advantage. The latest technical bulletin, explaining Type R in detail will be included upon request. Amateurs and experimenters who pride themselves on the proficiency of their apparatus will want to build and own this perfect power unit. Write today.

TYPE R	TYPE BH
90 Volts. 60 m.a.	125 m.a. at 300 Volts
Price $4.00	Price $4.50

Raytheon Manufacturing Co.
301 Kendall Square Building
Cambridge, Mass.

Raytheon
LONG LIFE RECTIFYING TUBE

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

GIVE HIM THIS

Sent on Trial

Waco Craftsman's Wonder Home Work Shop

$10.00 DOWN

What finer Gift could a family make to Husband, Father or Son?

What a wonderful gift to the man who loves to work, make, build and create. You keep feeding work and ideas to the "Red Jacket" and it completes each job so quickly, so interestingly and so perfectly that the results urge you on to greater accomplishments. Anything and everything is possible to the owner of a

Red Jacket Waco Craftsman's Lathe

It is a complete chest full of electrically driven tools designed by a master for the private use of tool lovers and men who create, repair and appreciate handy tools at home.

The Complete Equipment consists of the powerful Red Jacket Drill Motor with direct drive to the Waco Craftsman's wood turning lathe (capacity 9 in. x 34 in.); a bench saw, that has depth and side gauges, scroll and jig saw; and all accessories for both portable and stationary power drilling, buffing, grinding and cleaning. Attaches to any light socket and converts your work bench into a complete private tool and machine shop.

The Famous Waco Red Jacket Guarantee

If our tools are not what you want when you see them, send them back.

Look Out For Imitations: There is only one Red Jacket, one Waco, one Wm. L. Aylward, mastercraftsman.

Special Crafts Course And blueprint service is free to Red Jacket Shop owners—all that there is to know about handicraft methods, raw materials, woods, carving, sawing, turning, designing, carpentering, decorating, is taught by special correspondence. free CRAFTS COURSE

Buy On Your Own Terms Only $10.00 down. Liberal discounts for cash. Easy monthly payment plans. It is no hardship to own a Red Jacket.

Interesting Literature Free Send the coupon. You will be surprised with all it contains. Beautiful, Instructive, Fascinating, Interesting. free BLUE PRINTS

10 DAYS' FREE TRIAL.

Our literature tells you how to start a job of your own. If you are not pleased return the Shop.

This Headstock furnished where no electricity is available

Turning, Sawing, Winding, Spinning, Grinding, Buffing, Polishing, Cabinet Making, Scroll Sawing, Drilling, Repairing, Dove tailing, Pointing, Jointing, Sharpening, Sanding, Scratching, Carving, Successful Master pieces

MAIL THIS TO WACO

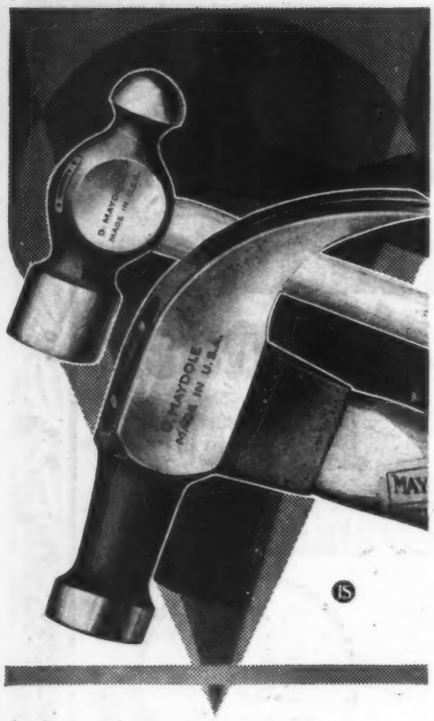
WACO TOOL WORKS, Inc.
542-4 N. Parkside Ave., Chicago, Ill.

Manager, Dept. 12. Please send me particulars about 10-day free trial, free blueprints, and $10 down payment.

Name.....

Address.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



Maydole Hammers

The choice of three generations of skilled American craftsmen • •

Heads press-forged of finest tool steel. Handles of clear, second-growth, air-seasoned hickory—put on "for keeps." There is a style and weight of Maydole for every service—each with the unequalled Maydole "hang" and an inbuilt resistance to hard use and abuse that means true economy.

Write for interesting and useful Pocket Handbook 23 "B." It's free!

YOUR HAMMER SINCE 1843
Maydole Hammers
The David Maydole Hammer Co., Norwich, N.Y.
1167

A Doll's House

(*Continued from page 104*)

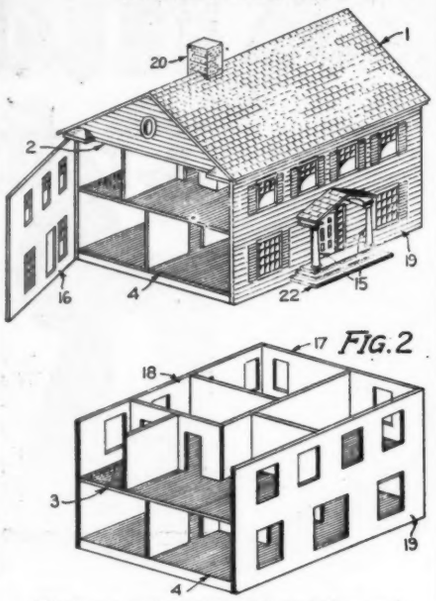


FIG. 2

The floors, walls and partitions before and after the roof and trimmings are added

placed even with the edge of the openings, frames will not be needed. The baseboards should be ¾ in. wide and the same thickness as the casings.

The stairs will be found to be the most difficult part of the construction. It is hardly possible to show their construction fully enough, but the details can be supplemented by the reader's observation and ingenuity. The construction of the stairs is indicated in Fig. 4. The stair steps may be glued to a thin board, each step being a solid block. Another plan would be to cut the steps from a solid block. Only the six lower steps are exposed to view, the other seven being hidden between walls Nos. 12 and 14. The stair well in the second floor is 3 by 7¼ in. and cut so that it is directly between walls 12 and 14.

The balustrades are made of match sticks glued between a top and bottom rail. The newel post may be a clothespin or a round penholder.

When all of the (*Continued on page 108*)

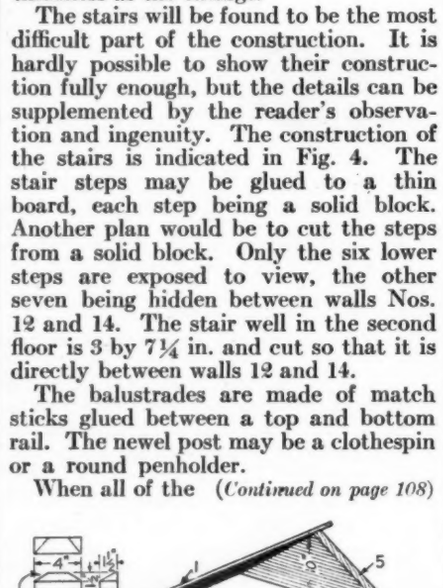


FIG. 3

The house is made in three parts; the small fittings are added before putting together

For Christmas a Ingersoll

When you give an Ingersoll Watch you make a gift that is appreciated out of all proportion to its cost.

For there's no gift like a watch, nothing used so much, consulted so often, carried so long. And Ingersoll Watches, made for over 35 years, have a reputation for dependability and enduring service that is world wide and thoroughly deserved.

If your dealer hasn't just the model you want, write us giving his name.

INGERSOLL WATCH CO., Inc.
New York • Chicago • San Francisco

YANKEE
The new improved model. More closely cased, antique bow and crown. Always dependable and sturdy
Yankee Radiolite, $2.25. **$1.50**

WRIST
Everybody needs a wrist watch. The time's in sight—at a glance. Usually dependable . . **$3.50**
Wrist Radiolite, $4.00.

YOU NEVER SAW A MOTOR LIKE THIS
6 CYLINDERS
REVOLVING MOTOR

THE HIGHEST GRADE and LIGHTEST AIR MOTOR ever produced. Designed and Perfected by an Expert Aircraft Engineer. A scientific wonder. Its first introduction has aroused unusual interest. Mechanical Experts have been generous in their comment. Also handle Castings for other Engines. Books and Supplies of every kind for HANDYMEN, MECHANICS and MODEL MAKERS.

Complete Catalogue 25c which is allowed on first $2 order.
Amalgamated Sales and Service Corp'n
327-R. So. LaSalle St. Chicago, Ill.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

FACTORY PRICES~SAVE $'s
Choice of beautiful cabinets offered

TRY IT 30 DAYS FREE
BEFORE YOU BUY

3 Year Guarantee

8 tube ~ one dial MIRACO

TRADE MARK REGISTERED

Only $69.75
Retail List Completely Assembled

MAGNIFICENT TONE~SUPER SELECTIVE~POWERFUL DISTANCE GETTER

All Electrified or Battery Set!

America's big, old, reliable Radio Corporation* (8th successful year) **guarantees** its big, powerful, latest 6, 7 and 8 tube Miraco sets to give one of "the finest, most enjoyable performances obtainable in **high grade** radios." Unless 30 days' use in your home fully satisfies you with its beautiful, clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc.—**don't buy it! Your verdict final.** Save or make lots of money on sets and equipment—write for testimony of nearby users and **Amazing Special Factory Offer.**

Miracos work equally fine with "AC" power units, on "AC" electric house current or with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons—testify they enjoy programs **Coast to Coast, Canada to Mexico,** good and clear—with magnificent cathedral tone quality due to genuine double impedance coupled "Truphonic" amplification—Note 4 transformers in view above. Don't confuse Miracos with cheap radios. Miracos have finest parts, latest approved shielding, metal chassis, etc. **Every tube is a useful tube in Miraco sets.**

Deal Direct with Big Factory

Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. **30 days' trial free.** 3 year guarantee if you buy. You take no risk, you insure satisfaction, you enjoy **rock-bottom money-saving prices** by dealing direct with one of radio's oldest, most successful builders of fine sets. 8th successful year in the radio manufacturing business.

Miraco Users Say:

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

CLEARER THAN A $450.00 SET
Before I bought your set I tried out and heard quite a number of different makes sets and I believe I can truthfully say that I never yet have heard a set with such wonderful tone and clearness as the Miraco. I never thought that a set could be as clear and reproduce tones and voices as the Miraco. Saturday I listened to a $450.00 set and it can't even come near your set for clearness and volume. I have logged some very distant stations on the Unitune and although people won't hardly believe me, the first week I had KFI Los Angeles on two nights in succession on a 50-ft. temporary inside aerial.—FRANK A. OLDENBURG, Milwaukee, Wis.

SHARPLY SEPARATES STATIONS
The Unitune brings in stations very clearly and with a selectivity that is amazing when you take in consideration the mass of stations on the air at the same time. I have heard three and four stations that were on almost same wavelengths at the same time and was able to tune out one after the other without the least interference.—W. L. BROBACK, San Francisco, Calif.

EXPERIENCED FAN PRAISES SET
Miraco is the most wonderful radio I have ever seen. I have had experience with many popular makes of radios, also have built a number of them myself but in tone quality it is far superior to all. For sensitiveness I can say it is more like a superheterodyne.—R. D. WHITE, Proctor, W. Va.

HAS POWER TO SPARE
"Well Pleased" with Miraco would be putting it mildly. Haven't heard anything to equal it regardless of price. With temporary aerial tuned in WEAF then WIOD Florida felt sure this must be WJZ the pet station of this locality. Stations all coming in clear with wonderful tone and tremendous volume. Seldom have more than half of volume turned on. A local agent insisted he could prove his set superior but to his surprise and astonishment my family and neighbors and the agent himself admitted his $165 set had to step out of the way for Miraco.—H. W. HOEPFL, Perkiomensville, Pa.

Another Big Bargain! Famous powerful big Miraco Super 6, 1928 model—ultra selective! Thousands find it outperforms sets of much higher price. **30 Days' Trial Free. Fully Guaranteed.**

Big Discounts to User-Agents

MIRACO "Powerplus" sets—both in 8 and 7 tube models—have magnificently beautiful, clear cathedral tone quality. Turn one dial for stations everywhere. Ultra-selective. Miraco multi-stage distance amplification gives "power-plus" on far-off stations. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. *Try one free for 30 days!* Choice of beautiful cabinets.

Electrify Any Radio with MIDWEST NO-BATTERY "AC" Light Socket Power Units

"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Midwest Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed.

BIG DISCOUNT TO User-Agent

Dealers Write!

USER-AGENTS! Make big profits showing Miraco to friends. Get Our Special Wholesale Prices!
MIDWEST RADIO CORPORATION, Cincinnati, O.

BEAUTIFULLY ILLUSTRATED CATALOG AND AMAZING SPECIAL OFFER

Free!

SEND NO MONEY—30 DAYS' TRIAL. Special Wholesale Price Offer to User-Agents, Bank References, testimony of nearby Miraco users—*all the proof you want*—sent with catalog.

mail coupon right now!

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
408-G Miraco Building, Cincinnati, Ohio.

THIS COUPON IS NOT AN ORDER

Without obligation, send free catalog, AMAZING SPECIAL OFFER, testimony of nearby Miraco users. ☐ User ☐ Agent ☐ Dealer

NAME

ADDRESS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

This Marvelous Tool! Pays $1000 a Month

No other wrench like it!

The First and Only "One Hand" Monkey Wrench

No Thumb Screw Adjustment—That simple slide motion locks securely with a hold that resists over 750 pounds end pressure. Compare this with any other wrench. Does away with the old thumb screw idea that was always a handicap. In every sense a "One Hand Monkey Wrench."

Mechanics Wild Over It

Any mechanic readily appreciates the greater convenience and efficiency of the H&E Wrench and wherever shown they are anxious to own one. As one mechanic puts it, "I don't see how I ever could do without the H&E Wrench." That simple slide motion gets their eye and it locks with a better grip and releases instantly.

Slides Up and Down—Locks Automatically

The H&E Wrench creates a sensation wherever shown. Its simplicity, smooth action, strong grip and practical value arouses interest everywhere. In the Factory, Machine Shop, Garage, on the Farm, or in the Home; in fact, wherever tools are used—they all go wild over it.

This Is Your Opportunity

Think of the big sales possibilities right in your locality and surrounding territory—even if you never sold anything in your life before, we show you how to be successful. In fact, under our plan you even get your H&E Wrench FREE.

Praised by Big Concerns

The C. B. & Q. Railroad and many other large Corporations have acknowledged its value and endorsed it. Automobile Owners want it for convenience and our Agents tell us "It is the easiest selling article they ever tackled."

500 Agents Wanted at Once

Rapid sales with a handsome profit make this a very attractive proposition for Agents and on account of this unusual demand we want agents everywhereand the opportunity is open to you NOW but you must ACT PROMPTLY.

MAIL TODAY

Pressure 8000 Inch Pounds

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Please mail me FREE particulars. This does not obligate me in any way.

NAME.....

ADDRESS.....

TOWN.....STATE.....

A Doll's House

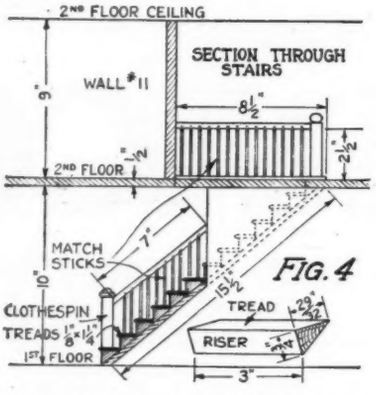
(Continued from page 106)

small details are in place and the walls tinted, the three sections shown in Fig. 3 may be assembled, using ¾-in. flat-head screws. The front and back should be screwed in place at this time and the two ends and roof hinged. One hinge on the roof will have to have an extension soldered to it to allow it to open out to the line of the chimney.

It is left to the reader as to what kind of roof he will use. Small shingles may be nailed or glued in place; they look well but take a great deal of time to construct. The divisions between the shingles may be represented by making grooves with the point of a nail set or a chisel. The same method may be used for lining the siding boards.

The chimneys are made of solid blocks of wood and the bricks carved with a chisel or sharp knife.

The construction of the front entrance



The stairs are made by gluing triangular steps to a thin board and adding tiny treads

is shown in Fig. 1 and more in detail on Blueprint No. 72. The arch is shaped with the coping saw; the roof boards are made to match the main roof. The columns may be turned on a lathe or made square, or a small bracket may be used to support the sides of the roof.

The steps in front and at the side are merely three ½-in. sections fastened together and carved like the chimneys. The sunburst design over the door may be carved with a knife or carving chisel.

Making up the window sash is more tedious than difficult. A good sharp knife will be the greatest asset. The method is shown in Fig. 6. Tough and quite heavy cardboard should be used. When the sash are cut, they are glued to a piece of glass or celluloid of the same width and length. Each sash should be made to fit its particular opening. The construction of the doors also is shown in Fig. 5.

Small green shutters serve to brighten the appearance of the house and may be made easily. A piece of very thin wood with a simple design grooved in the outside face is all that is needed for each shutter. These pieces are nailed to the side of the windows.

Small window boxes—blocks with holes for the flowers—may be used under the windows. Pieces of sponges, colored like plants and (Continued on page 110)

SW

"VERSATILE" BRIEF CASE

6-in-1

YOURS FOR 10 DAYS ABSOLUTELY FREE!

NEW, IMPROVED "VERSATILE" now has 6 pockets instead of 5! No increase in price. Combines Brief Case, Week-End Case, Traveling Bag, Sample Case, Catalogue Case, Accountant's Case—6 bags practically for the price of one. 17-inch size, top grain selected COWHIDE. Patented Steel Bar Construction prevents edges from sagging. Retains smart lines ALWAYS! COLORS:—Handsome Brown and Black.

(A) *Secret pocket, cleverly hidden; for valuable papers, bonds, reports, contracts, precious manuscripts, money, cash, etc.*
(B) *Pocket containing removable Toilet Kit.*
(C) *Fold-up Toilet Kit. Folds flat; may be carried to Pullman or hotel washroom. Ideal for business trips. Waterproof pockets for Hair Brush, Comb, Razor, Shaving Cream, Tooth Brush, Powder, etc. (See illustration over Brief Case.)*
(D) *Semi-stiff partition: for sketches, drawings, catalogues, magazines, stationery, order books, layouts, etc.*
(E) *Pouch Pocket for Pens, Pencils, Erasers, etc.*
(F) *Patented, disappearing flap—when pressed down, spreads bottom so that case STANDS UP as firmly as a suitcase. This flap also extends pocket (F) to great width for shirts, collars, socks, ties, extra trousers, underwear, etc.*
(G) *Utility pocket for odds and ends—6 pockets in all! You simply MUST see the "VERSATILE" Case to appreciate it.*

EXECUTIVES enthuse over "VERSATILE"

WE supply the "VERSATILE" to business men, bankers, traveling men, accountants, secretaries, salesmen, clergymen, architects, attorneys, teachers, students, etc. It is smart looking, "nobby" English tailored style. Stamps owner a person of importance. A real $20 Brief Case. Our "direct-by-mail" price for limited time to feature our LUGGAGE DIVISION is **$14.95**

Our Plan is Different!

It is the fairest, squarest offer that can be made. Send NO Money! Pay NOTHING on delivery! Use "Versatile" Brief Case for 10 Days' Trial ABSOLUTELY FREE! If pleased you may pay on Budget Plan:—

$4.00 MONTHLY

or, if you prefer to pay cash at end of 10 DAYS, deduct $1.20 and send check or Money Order for $13.75 in FULL SETTLEMENT. Otherwise return it. Order NOW. **$13.75**

SEAVER-WILLIAMS CO.
Importers, Exporters, International Mail-Order House
"2 Generations of Honorable Dealings"
365 WASHINGTON ST., BOSTON, MASS.
Sole distributors of "Versatile" Brief Case

Gentlemen—Send me $14.95 "Versatile" Brief Case for 10 Days' FREE TRIAL on "NO money in Advance—NO money on Delivery" Plan. Color desired.

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Clip and mail this coupon NOW! If a new customer, please tell us something about yourself. We will appreciate any respect the information. THANK YOU! Pop. Science 11-27

EXECUTIVES! "Versatile" makes ideal Christmas Gift to Personnel. Also Dandy Prize and Premium for sales force. Write for quantity prices.

Man! *How Easy*

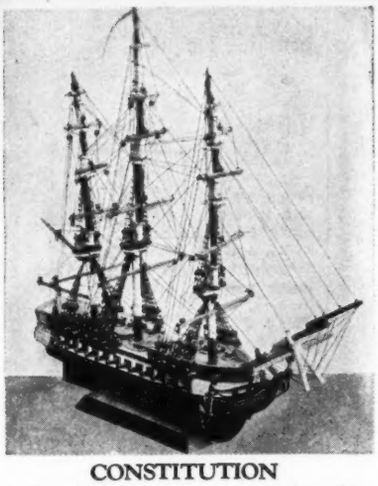
JUST a short period of pleasureable practice and you play pieces on the new Conn saxophone. 1927 models embody many new and exclusive features—easy playing, wonderful tone, perfect intonation, dependable mechanism.

FREE TRIAL; EASY Payments on any Conn instrument for band or orchestra. Send now for free literature and the details.

CONN BAND INSTRUMENTS

C. G. CONN, *Ltd.*
1232 Conn Bldg. Elkhart, Ind.

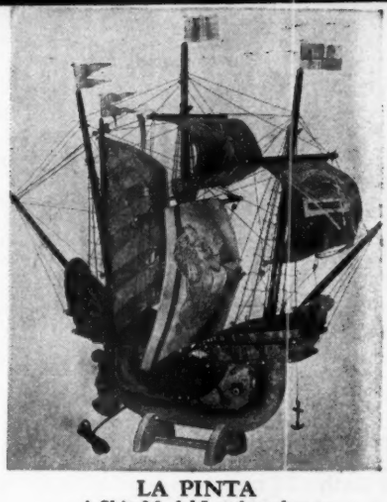
GETTING AHEAD?
Read the advertisements on Pages 146 to 174 this issue if you want to get ahead.



CONSTITUTION
Size: 30" high; 32" long; 10" wide (overall)

You can build a beautiful Ship Model as low as $4.98 or a Loudspeaker Ship Model for $12.50 with your own hands in a few hours of pleasant pastime from parts, cut to fit and ready to assemble, supplied by the largest builders of ship models in the world.

A fifteen-year-old school boy won first prize in a model building contest with a Constitution model built from our kit of parts. More than 1000 models were entered in this contest.



LA PINTA
A Ship Model Loudspeaker
Size: 26" high; 27" long; 12" wide (overall)

We will supply the parts for the Constitution (Old Ironsides) cut to fit and ready to assemble for $6.98. This price includes every part necessary for constructing the complete model. Full instructions for assembling Old Ironsides are included with each kit. A diagram of parts, showing the number of the parts and just exactly how to piece together the model, make it impossible for you to make a mistake. Other beautiful ship models can be built from our cut to fit and ready to assemble parts. We have kits for the Santa Maria, the La Pinta and the Mayflower at $4.98 each.

This is the most beautiful loudspeaker on the market. We will supply you with all parts necessary and complete instructions for building this beautiful loudspeaker ship model. The price of $12.50 also includes the melody sail and loudspeaker unit. The unit is of the Electro Magnet type and does not require power amplification to bring out the low notes as it gives faithful reproduction at all frequencies. The mainmast is deeply imbedded in the solid wood hull and the unit is attached to this mast, making it impossible for counter-vibrations to effect reproduction.

A USEFUL AND ORNAMENTAL HOME DECORATION

No doubt you have often admired ship models and yearned to possess one but could not do so because the price was too high. Let the WORLD'S LARGEST BUILDERS OF SHIP MODELS AND SHIP MODEL LOUDSPEAKERS supply you with all the necessary parts, cut to fit and ready to assemble from which you can build a beautiful model.

You need not know anything about ship building or carpenter work in order to build one of these ships. No special knowledge of ship model building is necessary either. We will supply all the parts, from the hull down to the smallest piece, all cut to fit and ready to assemble. You cannot go wrong. Diagrams and plans of parts that are included with each kit tell exactly what to do with each part.

These plans show you step by step just how the model is constructed. Everything is made so simple that even a small child can build a beautiful model.

All you need is a small hammer to tap the parts into place. Here is a part of the instructions copied word for word from the diagram and instruction sheet that goes with the kits. "Take part No. 57 place it in front end of part No. 56 and tap lightly with a hammer. Next take part No. 58 and place it up against No. 57 and tap it with a hammer to bring it into place."

Easy! Nothing simpler. The instructions are like that from beginning to end. Do this and that and before you realize it a beautiful ship model has grown before your eyes.

Write for our free, beautifully illustrated catalog, which contains photographs of all our models together with complete details and price of each. We will send this catalog without obligation to you. Fill in the coupon below and we will act upon it immediately.

If, after assembling the model according to our instructions, you do not think it worth many times the purchase price, return it to us in good condition and we will gladly refund your money.

MINIATURE SHIP MODELS, Inc.

3818-20-22-24 Baring St., Philadelphia, Pa.

***Canadian Branch:* 1485 Bleury St., Montreal, Canada**

Canadian Prices Slightly Higher. Send all Canadian Orders to Canadian Office.

MINIATURE SHIP MODELS, Inc., DEPT. O-3,
3818-20-22-24 Baring St., Phila., Pa.

Please send me complete parts, cut to fit and ready to assemble for the Constitution, $6.98 ☐; Santa Maria, $4.98 ☐; La Pinta, $4.98, ☐; Mayflower, $4.98 ☐. Melody Ships: La Pinta, $12.50 ☐; Santa Maria, $12.50 ☐; Mayflower, $12.50 ☐. I will pay postman purchase price plus postage (a few cents).
Check which model you want shipped.

PLEASE PRINT NAME AND ADDRESS PLAINLY.

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FOR both hand and machine work, Simonds Hack Saws are preferred by experienced mechanics. They know that Simonds Blades cut easier and faster—that the teeth will not shell—and that the high tungsten content gives longer life. For power saw use, specify Simonds All-Hard Blades—for hand use, Simonds Hard Edge Blades. But be sure to specify "Simonds" and thus secure the advantages of a near-century's experience in the manufacture of fine cutting edges.

SIMONDS SAW AND STEEL COMPANY

"The Saw Makers" Fitchburg, Mass. *Established 1832*

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We furnish blue prints, finishing material and instructions. Buy the works, dial, weights and pendulum from us at surprisingly low prices. You make a fine profit building artistic clocks for your friends.

Plain Works As Low As $5.00. Others with Chimes at All Prices. Ask for Attractive Free Offer.

AMERICAN CHIME CLOCK COMPANY

1691 Ruffner Street Philadelphia

PARKS

Manual Trainer

$35.00 without motor

For your home shop! Combination 11-inch band saw and 11-inch wood-lathe. If you have a knack for woodworking you can turn out first-class bridge lamps, cabinets, furniture, ship models, etc., in fast time. Get one!

Write for specification circular.

THE PARKS WOODWORKING MACHINE CO.

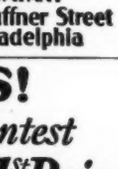
1547 Knowlton Street Cincinnati, Ohio

Canadian Factory: 208 Notre Dame, E. Montreal, Can.

BOYS!

Enter this Contest

$500.00 Cash 1st Prize



Every boy will want our new, thrilling and beautifully illustrated book. It is a most interesting story and tells you all about the new Meccano. It fully explains the fun and ease with which you can build hundreds of wonderful working models in colors, such as steam shovels, wrecking cars, cranes, bridges, etc. These models are exact duplicates of the real engineering machines from which they are copied.

With this book you will receive an entry blank for the great Meccano Prize Contest—first prize $500 in cash. You may be the lucky boy.

Write today. The book and entry blank will be sent to you free upon receipt of your name and address and the names and addresses of three (3) of your friends. Put No. K-2 after your own name for reference.

MECCANO COMPANY, Inc., Div. K-2, Elizabeth, N.J

MECCANO

A Doll's House

(*Continued from page 108*)

shrubs and glued on top of the boxes, are quite effective.

Careful painting adds greatly to the attractiveness of the house; it is one of the most important items. The colors suggested are green for the roof and shutters, white for all of the body and doors and window sash, and red for the steps and chimneys. It is well to give the house two or three coats of paint or brushing lacquer.

The inside woodwork should be painted white along with the doors. The floors may be stained or finished with clear varnish. Paper or tint the walls.

Furniture, bath and kitchen fixtures may be obtained ready made at the toy shops, where some substantial and well formed models are to be found. These should be of the proper size to match the house. It is more satisfactory, however, to make the pieces in the home shop. Full size designs for tables, chairs, a couch, a hall clock, a bed and other furnishings are given in Blueprint No. 73.

The porcelain fixtures for the bathroom and kitchen may be shaped or carved from solid wood to resemble as closely as possible the real pieces. These models are covered with a heavy layer of gesso made of glue and whiting and painted with white enamel to resemble porcelain.

FIG. 5

A simple way to make the sash and doors. The latter vary in size, as shown on Blueprint No. 72

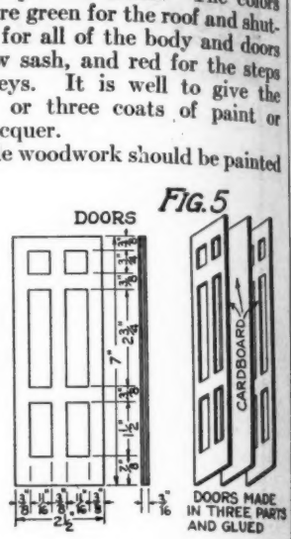
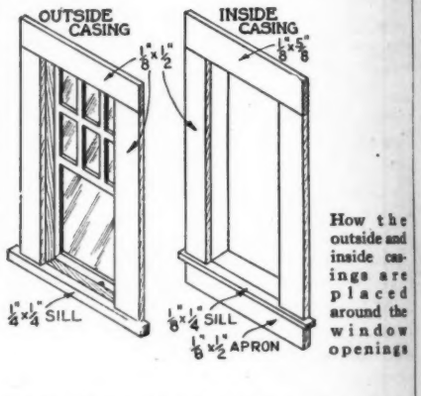


FIG. 6



How the outside and inside casings are placed around the window openings

Filter for Purifying Cistern Water

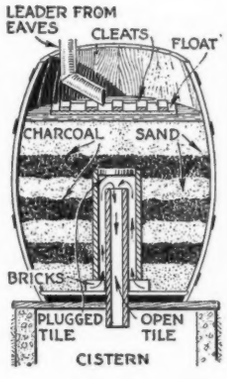
By M. G. KAINS

IN MANY places it is advisable or desirable to use water from cisterns rather than from wells; for instance, where the water is alkaline or brackish, or if there is doubt as to its purity.

When the owner does not feel justified in going to the expense of building a filter cistern, the method described below will serve the purpose. The apparatus is nothing more than a filter placed above ground, preferably on top of the cistern.

A properly constructed cistern is supposed to be already installed and well lined with cement. Also, the usual provisions for cleaning it should have been made, even though cleaning will rarely have to be done.

In the center of the bottom of a strong, water-tight barrel or large cask, bore a hole large enough to accommodate a 3-in. vitrified drain tile, which must be fitted snugly in place and cemented all around to prevent leakage. Beside it, on the bottom of the barrel, place two bricks. Cement or otherwise fasten them to the bottom to prevent their shifting.



Sectional view of a filter for a cistern

Plug with cement the small end of another vitrified tile of a size large enough to slip over the 3-in. tile. This is to prevent water from leaking through at that end. After the cement has set, invert this tile over the small one, the top of which will be about 2 in. below the plugged end of the large tile because of the bricks upon which it rests. The bell end of the large tile is the one that rests upon the bricks.

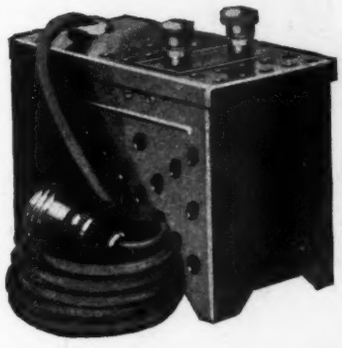
The barrel must be placed so that the tile in its bottom passes through a hole in the top of the cistern, or so that it connects with a pipe to conduct the filtered water into the cistern. Then the barrel is two thirds filled with sand and powdered charcoal in alternate layers each of 3 or 4 in.

A float nearly as large around as the barrel head is placed upon the top layer of sand. This is to spread the water as it pours in from the eaves leader and prevent the sand from being stirred up unduly. A cover upon the top of the barrel will keep out dirt that might come from other sources than the roof. The apparatus is now complete.

The upper layer of sand, which should be at least 6 in. thick, will catch all dirt from the roof. Therefore, it should be cleaned at intervals and occasionally replaced with fresh sand. Once or twice a year it will be well to replace all the sand and charcoal with fresh layers.

A Trickle Charger that is Absolutely DRY!

Price Complete
$10.50
nothing else to buy. Larger model $18.50



No acids, liquids or bulbs—
never requires watering or attention!

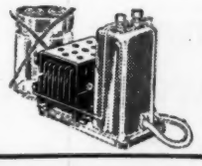
Here at last is an absolutely dry trickle charger. No more of the bother and worry—none of the watering and attention that former trickle chargers required.

The KUPROX Trickle Charger contains no acids, or liquids—it uses no bulbs of any kind. Constructed entirely of metal it needs no watching or watering—no attention of any kind.

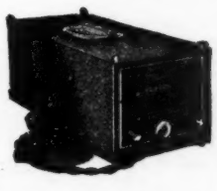
You never have to worry about your battery running down after you install the KUPROX Trickle Charger. It supplies a full 1-ampere trickle rate, (the larger model also provides a 2½-ampere booster charge). To attach the KUPROX Trickle to your battery is to have a real trouble-proof power unit.

Your radio dealer is displaying the KUPROX Trickle Charger along with the remainder of the complete line of KUPROX Dry Radio Power Devices. See Them.

Make your wet charger DRY!
Replace the acid jar with the dry KUPROX all-metal Replacement Unit. Your charger will never need watering or attention. $4.50 at any dealer's.



KUPROX
RADIO POWER DEVICES



KUPROX "A" TRANSIFIERS—Batteryless, noiseless, electric "A" power. Dry, dependable, needs no attention. Operates any receiver. 4-volt or 6-volt, $28.50 and up.

KUPROX A & B TRANSIFIERS—All radio power from a single unit. Controlled from set switch. Absolutely dry, requires no attention. $57.50 and up.

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Send for the booklet illustrating the complete KUPROX line of dry Power Devices.

THE KODEL RADIO CORP. 500 E. Pearl Street CINCINNATI, O.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Only Plumb Tools have this remarkable Screw Wedge which retightens the handle just by a turn of the screw. You can do better work with a safe, tight tool. Use a Plumb!

This

PLUMB Hammer can be tightened—

just by a turn of the screw

You know what this means to you. You have often found your hammer head so loose as to be unsafe or unfit to use.

With a Plumb you have no working with a wobbly tool—no bothersome rewedging.

You just turn the Plumb Screw Wedge,—and instantly your hammer is tight again . . ready for accurate work.

Perfect balance! The face falls squarely on the head of your nail.

A rugged handle! Made of selected hickory. Each handle tested by a 400-lb. falling weight on the spring of the neck.

Ask for a Plumb—a lifetime tool. It has the Red Handle and Black Head. Only $1.50 for the HF81, 1 lb. model. (Slightly higher in Far West and Canada.)

FAYETTE R. PLUMB, INC.
Philadelphia, U.S.A.

PLUMB
DOUBLE LIFE
Hammers Hatchets
Files Sledges Axes

How to Drive Your Tool Grinder by Foot Power

A CHANGE in our home electrical system deprived me of a motor-driven tool grinder. I fell back on a hand-turned grinder and worried along with it for quite a while. This often meant enlisting family assistance, with few volunteers. A bright thought: why not foot power? The foot device could be bought, but perhaps it could be made just as well out of odds and ends.

First, the crank of the grinder was shortened a couple of inches with a hack saw, leaving the first bolt hole to which the turning handle had been attached.

Grinding tools in the home workshop becomes much less of a task if a pedal attachment is made for turning the hand grinder

For the long connecting rod from grinder to pedal, I selected an old hockey stick, cutting it off 2 ft. 6 in. long. A hole was drilled through one end for a bolt to attach it to the grinder crank. At the other end the stick was T-hinged to a board pedal, and the latter in turn was supplied with a larger T-hinge to be fastened to the concrete floor.

The first model, done offhand and in a hurry, was a sad failure. The dejected inventor suspected that he had violated some unknown but vital principle laid down by Archimedes. He scratched his head and surmised that perhaps the pedal was too short. So he substituted a longer board—one 4 in. wide and 2 ft. long. It worked. All that remained was to anchor the larger hinge to the floor with bolts held with melted lead in drilled holes. Instead of lead, ordinary cement or 24-hour-hardening cement could have been used.—J. R. McM.

Anyone Can Make Repairs With PLASTIC WOOD

A loose tile in the bathroom—furniture chipped or gouged—screw holes that have served their usefulness—a leak among the shingles. A carpenter's time costs money—with Plastic Wood you can do the job yourself. Make repairs in the modern way—and it's fun to do it too. It handles like putty and hardens into wood, with every wood property except the grain. Recommended for use under lacquer.

¼ lb., 35c.; one pound $1.00
Sold by Hardware and Paint Stores. Send coupon if they cannot supply you

ADDISON-LESLIE COMPANY
32 Bolivar Street, Canton, Mass.
Please send me ¼ lb. can of PLASTIC WOOD for which I enclose 35c.

Name.....

Address.....

Build This Gorgeous SPANISH GALLEON

Complete Instructions and Plans Only $1.00

One of the most colorful and beautiful of ship models—designed for Popular Science Monthly by the famous model builder Captain E. A. McCann. Anyone can make it who can use tools. We supply complete description and instructions, together with photographic reprints of important parts, and a reproduction of the galleon in full color, complete detail charts, together with two full size Blue Prints. All mailed postpaid in a handsome container for only $1.00.

Materials will cost only about Five Dollars. Your model, when completed, may be worth $250.

Send check, money order or dollar bill.

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POPULAR SCIENCE MONTHLY
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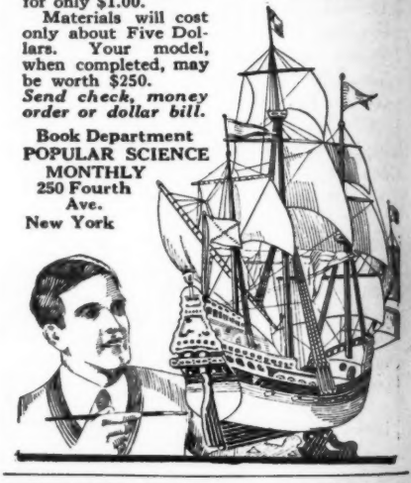

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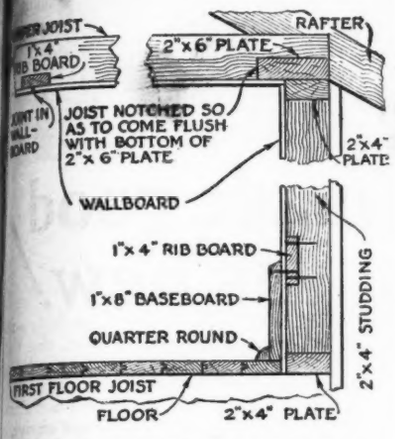
labels, paper, circulars, tag menus, book etc. Save money and time, cut cost in half. Sold direct to you from factory. **Print for Others, Big Profits.** Complete Outfits, $8.85 up. Presses $11 up, Rotary $149. All easy, rules sent. Pays for itself in short time. Write for catalog presses, type, paper, cards etc. THE KELSEY CO., B-33, Meriden, Conn.

HB ONE DAY BATTERY CHARGING
Pays $150 to $300 Monthly Profits
Start your own big business now. Small payment brings complete outfit for recharging auto and radio batteries. Easy terms. Money back guarantee. Write to
HOBART BROS. CO.
Box P127, Troy, Ohio
ONLY $16.50 MONTHLY

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

A Workmanlike Way to Apply Wallboard

WHEN building a house which is to be lined with wallboard instead of the regulation lath and plaster, time will be saved and a better job will result if the builder takes the forethought to cut notches in the studding and joists of a size to receive a 1 by 4 in. rib board, as shown. The rib on the 2 by 4 in. studs should be located so as to come a little above the baseboard, and the ones on the



How the ribs and plates are arranged to insure adequate bearing and nailing surfaces

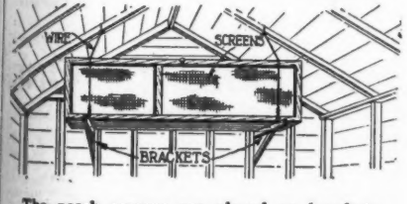
ceiling joist wherever the joints in the wallboard will come.

Instead of the usual 2 by 4 in. double plate, use a 2 by 6 in. plank for the upper member. This gives a nailing space of 2 in. all around for the wallboard. The ceiling joists are sized at the ends so as to come flush with the under face of the 2 by 6 in. plate.

This method will be found to be a great improvement over the usual way of "cobbling" in scrap pieces here and there to get bearing and nailing surfaces for the edges of the wallboard sheets.—GEORGE W. ROYER.

Storing Screens in a Garage

FOR storing screens I use the single 2 by 4 in. beam across the center of the garage just under the pitched roof. Three cross members are nailed on top of the beam so that they support the top, bottom and center members of a screen door.



The porch screens are placed on brackets extending from the end wall of the garage

On top of the door I pile all the wooden screens.

When I inclosed the front porch with portable screen panels, there was not sufficient room on the top of the single cross beam to store them, but I put up two braces as illustrated on the end wall of the garage.—J. F. HARDECKER.

Give the Handyman at Home a
Carborundum Combination Stone

MAKE him happy this Christmas with the gift of a Carborundum Combination Stone. It will complete his tool kit. It will bring him the joy of always having sharp, clean-cutting tools.

A Carborundum Combination Stone quickly and easily puts an edge on his chisels, plane bits, carving tools, etc.—the tools that he so lovingly uses in making gifts for others.

He will then really have two sharpening stones in one, for the Carborundum Combination Stone has a coarse side for taking out nicks and bringing the tool to an edge—a fine side for giving the keen finished edge.

And there is no other material that is so hard, sharp and cuts with the speed of Carborundum—a manufactured abrasive.

HARDEST AND SHARPEST — REG. U. S. PAT. OFF.

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

Carried by Hardware Dealers Everywhere

Send for Catalog P-1 for Complete List of Carborundum Products

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.
CANADIAN CARBORUNDUM CO., LTD.
NIAGARA FALLS, ONT.
Sales Offices and Warehouses in
New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Grand Rapids, Milwaukee
The Carborundum Co., Ltd., Manchester, England
Deutsche Carborundum Werke, Dusseldorf, Germany

Carborundum
REG. U. S. PAT. OFF.
ABRASIVE PRODUCTS

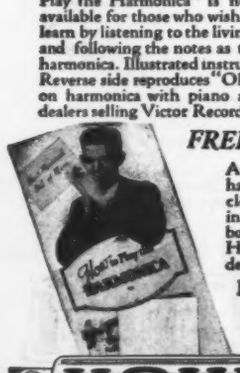
Get Ready to Join a Harmonica Band!

YES, you can learn to play as well as the next fellow. All you need is a Hohner Harmonica, our free instruction book, and a little practice — and first thing you know, you'll be reeling off the tunes like a veteran!

Pretty soon you'll be looking round for some other chaps to join you in a harmonica band—and that's when you'll really appreciate what fun there is in being able to play this "miniature orchestra."

There are harmonica contests, too, in which thousands of boys take part—and some mighty handsome prizes waiting for those who win!

A special orthophonic Victor Record (No. 20377) "How to Play the Harmonica" is now available for those who wish to learn by listening to the living voice of the instructor, and following the notes as they are sounded on his harmonica. Illustrated instruction sheet also included. Reverse side reproduces "Old Black Joe" as rendered on harmonica with piano accompaniment. At all dealers selling Victor Records . . . complete 75c



FREE Instruction Book

Anyone can learn to play the harmonica by following the clear, simple, illustrated instructions given in our booklet "How to Play the Harmonica." Free at your dealer's—or write to

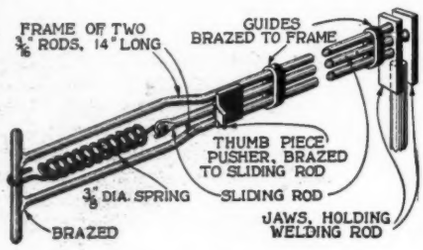
M. HOHNER, Inc.
Dept. 504
114 East 16th Street
New York

HOHNER Harmonicas

Quick-Acting Holder for Short Welding Rods

WELDING rods seem to be regarded cheaply by some welders, but in a month's time a considerable amount of money will be represented by the pile of short ends accumulated in a busy shop.

One way of using up the short ends is to fuse the pieces together, usually as the work goes on, by welding the short rod to


FRAME OF TWO ⅛" RODS, 14" LONG
GUIDES BRAZED TO FRAME
THUMB PIECE PUSHER, BRAZED TO SLIDING ROD
⅜" DIA. SPRING
SLIDING ROD
BRAZED
JAWS, HOLDING WELDING ROD

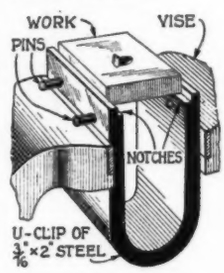
How to make a holder which allows short bits of welding rods to be handled safely

the end of the succeeding one. However economical this may seem, it costs something in gas and time to stick the rods together, so the saving may be more imaginary than real.

A sure way to save the rods, without expense, is to use a rod holder such as is illustrated. The one shown can be made in a few minutes' spare time, and is used to hold the welding rod when it gets too short to be safely held in the fingers.—WILLIAM J. REESE.

Clip for Vise Expedites Filing of Thin Work

SMALL die parts, or other thin pieces similar to that shown in the illustration, are very difficult to hold in a vise without scarring the edges, if they can be held at all. In addition, there is the danger that the file will be damaged by the contact with the hard jaws of the vise.



Holder for thin work which is to be filed

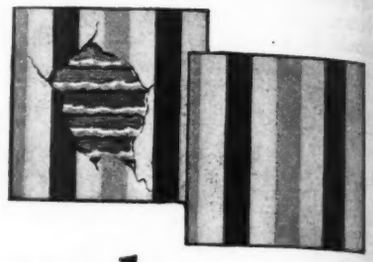
A strip of thin soft steel, provided with notches to receive the work and bent as illustrated, will solve these difficulties. If desired, pins can be added to hold the clip at the proper height.

Clamp Puller for Shafts

A puller of simple design for extracting stubborn shafts

THIS extractor was made for removing shafts from holes, withdrawing dowels that cannot be driven out, and similar work. It looks like the conventional clamp dog, except that it has two set screws.—G. A. L.

CRACKED WALLS—



made good as new!

WHEN you fill a crack or hole with Rutland Patching Plaster, the wall looks as good as new. And the patch is as lasting as the wall itself.

Rutland Patching Plaster will not crack, crumble or fall out. It will not shrink as plaster of paris shrinks. It's easier to use than plaster of paris because it does not get hard or "set" instantly. Comes in handy cartons. You just add water and apply.

Paint, wall paper and hardware stores sell it. If your dealer hasn't Rutland, we will mail a package direct and you can pay the postman 30c. plus postage. Rutland Fire Clay Co., Dept. R-15, Rutland Vermont.

Rutland Patching Plaster

$35 COMPLETE WITH MOTOR F.O.B. Chicago

18 TOOLS IN ONE

Greatest Machine You Ever Saw

The S&B 8-in. Combination Saw (18 tools in one) is the ideal machine for the shop, factory or the home; will rip, cross cut, bevel, miter, mortise, groove, drill, tenon, grind, rabbet, buff and polish. Motor is mounted on a base that is a part of the machine proper. Complete with attachments and price includes ½-H.P. Motor, 60-cycle, 110-volt A. C., run from any light socket. Shipping weight 100 lbs.

Write for Complete Illustrated Folder

SCOTT-BANSBACH MACHINERY CO.
130 So. Clinton St., Dept. 58, Chicago, Ill.

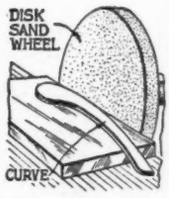
Getting Ahead?

Read the advertisements on Pages 146 to 174 this issue if you want to get ahead!

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Making French Curves for Drafting Use

THE problem of supplying draftsmen with sufficient irregular curves (French, ship or railroad) has always been a rather hard one to solve. If the company buys them, they are continually getting lost or misplaced; if, as is generally the case, the individual draftsman is left to provide them, some men neglect to do so and are continually trying to borrow them.



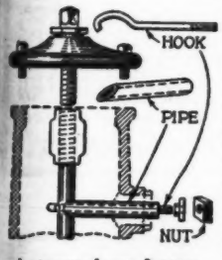
The curves are sanded smooth

One concern solved this difficulty by purchasing 1/16-in. sheet celluloid, which is supplied to the men with permission to use the shop facilities in their own time to make their own curves. As the shops work one hour later than the drafting force, this was easy to arrange.

The accepted method of making the curves is to lay an existing curve on the celluloid sheet, scribe its outlines, tack the sheet to a thin piece of wood and cut it on a fine band saw, leaving sufficient margin for trimming. It is then removed from the wood and carefully finished by freely swinging it back and forth across a sanding wheel.—J. F. HARDECKER.

Hooklike Tool for Repairing Fire Hydrants Quickly

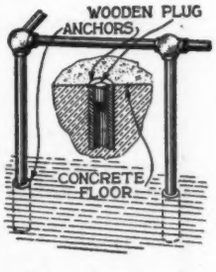
IN REPAIRING anything about the top part of fire hydrants, C. R. Dale, Superintendent of the City Water Works of Galena, Kansas, saves time by using the simple tool illustrated. It is obvious that a similar device could be used for other purposes where a pipe or shaft has to be kept from turning in an inaccessible place or some position which will not allow an ordinary pipe, chain or strap wrench to be used to advantage.



A strong clamp for use in awkward places

Sockets Placed in Concrete Floor to Save Drilling

WHEN supervising the laying of a concrete floor in a building which was to house electric transformers, the foreman ordered the placing of a number of 1-ft. lengths of 1¼-in. iron pipe vertically in the concrete. These were inaddition to the usual supports for the machinery. They shortly proved useful and justified his foresight when additional guard rails had to be erected.



Using short lengths of pipe as sockets

Holes are so frequently required in shop floors that it often would pay to place short pipes at 5- to 8-ft. intervals.

NEW TWIN BLADE CLEANER
WIPES YOUR WINDSHIELD
STRAIGHT ACROSS . . . $8.50

5-PLY BLADE WIPES CLEAN

New Trico Pyramid 5-ply rubber blade fits all windshield cleaners of the suction type. Wipes clean. Can't scratch. No chemicals, 35 cents in United States. Mailed postpaid if dealer cannot supply you.

DEALERS

This new twin blade automatic Visionall will be in great demand this winter. Anyone can install it. Guaranteed satisfactory. If your jobber can't supply you write us today.

CRYSTAL clear vision for driver and passenger! A powerful, noiseless motor, driven automatically by the well-known suction principle, equipped with two vertical blades which slide smoothly back and forth, *clearing your whole range of vision.*

The Visionall clears 254 square inches of glass—more than twice as much as the average cleaner!

Blades do not swing in a half circle, but wipe straight across, allowing the water to run freely down off the end of each blade. One model fits all cars. Easily installed.

The price is only $8.50 in United States. Get your Visionall today. Be prepared for dark stormy nights that are coming. If your dealer can't supply the Visionall, we will mail one postpaid for $8.50 with simple instructions for installing. Trico Products Corporation, Buffalo, New York. *World's largest makers of windshield equipment.*

TRICO
VISIONALL

TRICO PRODUCTS CORPORATION, BUFFALO, N. Y.

As advertised in Popular Science Monthly, please send me one Trico Visionall with instructions for installing. I enclose draft or money order for $8.50. I have written my dealer's name in the space below.

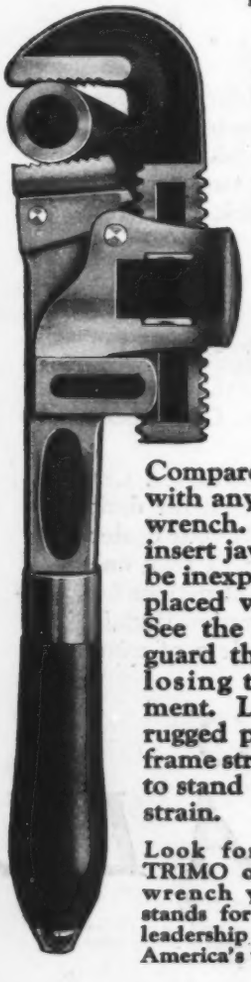
Name .....

Address .....

Dealer's Name .....

Take The Word Of A Satisfied Plumber

"I've used wrenches enough to know something about them. Whenever I want a pipe wrench, I always ask for a TRIMO."



What this plumber has discovered in a life time's experience, you can demonstrate to yourself in a few minutes.

TRIMO

Compare a TRIMO with any other pipe wrench. Notice the insert jaws that can be inexpensively replaced when worn. See the handy nut guard that prevents losing the adjustment. Look at the rugged pressed steel frame strong enough to stand the hardest strain.

Look for the name TRIMO on every pipe wrench you buy. It stands for 40 years of leadership in making America's wrenches.

TRIMONT MFG. COMPANY
Incorporated
Roxbury (Boston), Mass.

Lathe Used in Emergency to Cut Long Keyway

By GEORGE A. VOLZ

IT HAS been said that the engine lathe is the foundation of machine shop practice and that any other machine tool could be dispensed with much more easily than it. Examples of its versatility are often found. Lathes are used for milling operations, for facing that is really planer work, and, in the set-up illustrated, for keywaying a long arbor for a milling machine.

This arbor was made for some special work. It was complete with the exception of the keyseat when I found there was no milling machine, shaper or planer available in which to do the keywaying, so I proceeded to do the job in the lathe.

A starting hole was drilled next the collar on the arbor, which was then placed

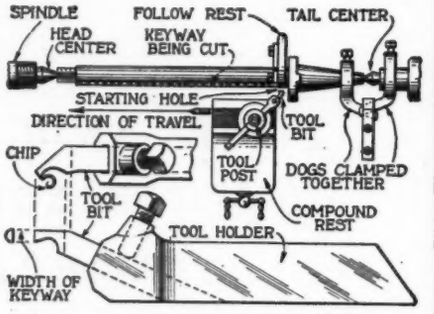


Diagram showing set-up and tool bit used for keywaying a long arbor in a lathe

between the lathe centers. The follow-rest was set up to the arbor. A tool bit was ground as shown and set precisely on the center of the lathe and at a negative angle to avoid digging and chattering. It was placed diametrically opposite the rear jaw of the follow-rest.

One lathe dog was placed on the arbor shank and another on the tailstock spindle. The arbor was turned until the tool would enter the starting hole. The two dogs, after being brought into contact with each other, were tightened and clamped together to hold the arbor so that it could not turn out of line.

The lathe was geared to cut a coarse thread and run in back gears. The live center was well oiled to lessen the tendency of the arbor to revolve.

The tool was fed in to take a light cut, the lead screw nut thrown in, and the carriage run the length of the arbor. The tool was withdrawn, the nut disengaged, and the carriage returned to take another cut, just as would be done in chasing a thread. It did not take many cuts or much time to finish the keyway cut.

Ordinarily, of course, the cut would have been taken toward the tailstock, but the collar on the arbor prevented that.

WHEN GRINDING taper shanks on arbors for milling machines, end mills, or any tool having a taper shank, more satisfactory results will be obtained, especially in the case of old machines, by relieving one third of the length of shank 1/16 in. under size. This causes the bearings to be on the ends.—H.J.C.

The Old Reliable Credit Jewelers

LOFTIS BROS. & CO. Dept. G871 108 N. State St. Chicago Ill.

DIAMONDS AS LOW AS $1.00 A WEEK

Genuine Diamonds Guaranteed
CASH OR CREDIT

Beautiful Diamonds for Christmas!
Diamonds for Christmas at a great saving! Dazzling gems of fine blue white color—all special importations—exquisitely set in mountings of solid 18-k white gold. Buy direct from Loftis, the importer, and save what others pay to middlemen. Order now—direct from this ad!

Satisfaction guaranteed, or money back. Goods sent for your free examination on request. Credit Terms: Pay one-tenth down; balance weekly, semi-monthly, or monthly at your convenience. All goods delivered on first payment.

No. 877 $50 $1.25 a wk.

No. 879 $150 $3.75 a wk.

No. 830 $75 $1.75 a wk.

No. 979 $100 $2.50 a wk.

No. 884 $67.50 $1 a wk.

No. 867 $100 $2.50 a wk.

Christmas Catalog Free!
Big 132-page book, illustrating our Diamonds, Watches, Jewelry, Silverware, and gift articles for all occasions, sent absolutely free. Write today.

Rectangular Wrist Watch No. 888
Solid 14-k white gold, 15 Jewels, Gold filled bracelet to match. $68. $3.50 down, $3.50 a month.

Cushion Strap Watch Nickel, 6 Jewels—high grade Leather strap. Special $8.50

Railroad Watches—
Guaranteed to Pass Inspection

Wedding Rings
No. 824—The "Elite" solid 18-k white gold . . . $7.50
Set with 3 Diamonds, $22.50; 5 Diamonds, $32.50; 7 Diamonds, $42.50; 9 Diamonds, $52.50; 12 Diamonds, $67.50. All platinum, $25. With 3 Diamonds, $50; 5 Diamonds, $70; 7 Diamonds, $80; 9 Diamonds, $100; circled by Diamonds, $200.

HAMILTON NO. 992, 21 Jewels, Adjusted to 5 Positions, Gold filled 25-Year Quality Case . . . $55

ELGIN'S LATEST RAYMOND, 21 Jewels, 8 Adjustments, Runs 40 hours one winding. Gold filled 20-Year Quality Case $55

ILLINOIS "BUNN SPECIAL" 21 Jewels, Adjusted to 6 Positions. Gold filled 25-Year Quality Case. 60 hours, 1 winding . . . $50

Credit at Cash Prices

Send for Free Catalog!

CHEAPER POWER

Sizes 2 to 30 H-P.

Burns Kerosene, Gas-Oil Gasoline, Distillate or Gas

Delivers power far in excess of rating on cheapest fuels. All parts interchangeable. Equipped with WICO Magneto, die cast bearings, speed and power regulator and throttling governor. Scrap your old engine—pay a little of it down on a New WITTE on my EASY PAYMENT PLAN.

WRITE TODAY FOR MY FREE ENGINE BOOK!

No obligation. And, if interested, ask about Log and Tree Saws, 3-in-1 Saw Rigs or Pump Outfits.—*ED. H. WITTE, Pres.*

WITTE ENGINE WORKS
2229 Witte Bldg., KANSAS CITY, MO.
2229 Empire Bldg., PITTSBURGH, PA.

WRITE TODAY FOR NEW ENGINE BOOK FREE

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

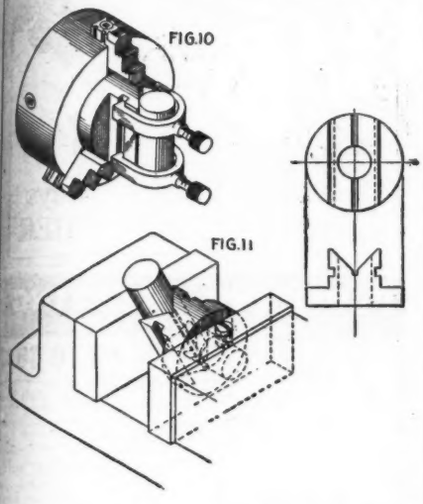
Using the Vee

(*Continued from page 78*)

which locks the work firmly in a three-point contact ready for drilling. The head of the spreader pin prevents the drill from striking the ends of the hardened vees, while permitting the maximum support for the work.

Off-center drilling can be done by the same method, merely by inserting a size

This fixture helps in boring round stock and can be pivoted as illustrated for milling cuts



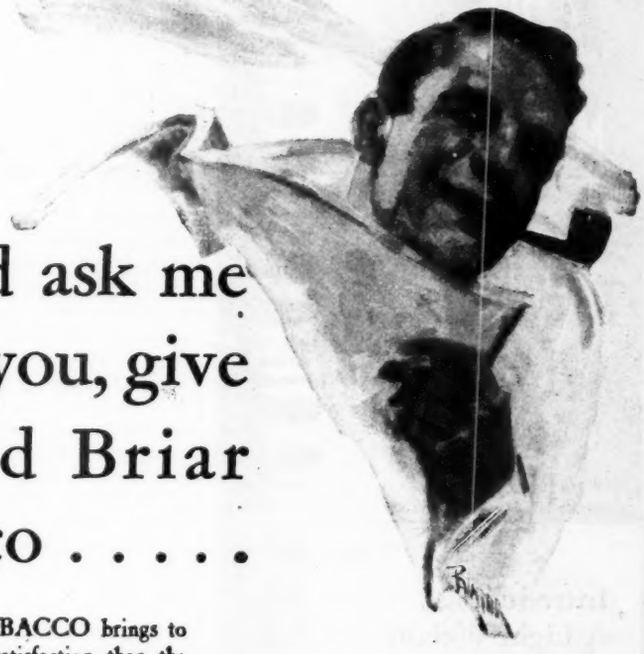
block or shim of one half the desired offset behind the vees and another in front of the drill block, as in the diagram of Fig. 8.

A variation of the regular vee-block which can be made in a very short time and which is useful for very small work is shown in Fig. 4. The set of blocks illustrated has a series of grooves, each corresponding to successive variations in the diameter of the work of 1/64 in. Non-shrinking tool steel should be used for these blocks, a pair of which are made in a single piece enough longer than the finished set to allow for finishing the ends. Before milling, this piece is first ground square on all four sides. Next the grooves are milled. The block is then cut in two, the ends finished, and the pieces hardened. Blocks of this kind are often useful in holding small parts of varying diameter, as indicated in the illustration. They can also be used for squaring the ends of soft wire or small rods in a vise, as shown in Fig. 5.

In forming the grooves, it should be noted that in order to get a certain difference in diameter of the parts held in them, it is necessary to vary the depth by 1.414 times the difference in radius, or .707 times the difference in diameter, as will be seen from Fig. 3. To get a variation of 1/64 in., therefore, we must drop the miller table a distance of .0156 in. times 1.414 or .022 in.

Another type of vee device which is designed to use standard parts is the one in Fig. 7. This small center drill jig is complete within itself, with vees and bushings interchangeable. As will be seen, it is largely completed on the lathe, the only additional work required being the formation of (*Continued on page 118*)

Old Briar
TOBACCO
"THE BEST PIPE SMOKE EVER MADE!"



If you'd ask me I'd tell you, give me Old Briar Tobacco . . . . .

OLD BRIAR TOBACCO brings to men far more satisfaction than the usual gift. All of the genuine pleasure, solace and the cheer of pipe smoking is in this gift. Men, everywhere, welcome Old Briar as they've never welcomed *tobacco* before. It gives them many hours of complete contentment at home—repose and satisfaction! Such comfort and pleasure is beyond price.

Light up your pipe filled with Old Briar Tobacco. Draw in its ripe fragrance and full-bodied aroma. Enjoy its natural tobacco flavor—its satisfying taste. Notice how cool it is—and how smooth. Now you know why Old Briar Tobacco is *One* gift every pipe smoker will welcome.

It has taken experts, with years of scientific knowledge in the art of mellowing and blending, with generations of tobacco culture back of them, to produce Old Briar Tobacco. Step by step Old Briar has been developed—step by step perfected. *It all shows up in the smoke!*

Make a Gift of Old Briar Tobacco to Yourself This Christmas and to Every Friend Who Enjoys His Pipe. Of All the Pleasures Man Enjoys Pipe Smoking Costs the Least.

IF YOUR DEALER DOES NOT HAVE OLD BRIAR

Tear out this coupon and mail to: P.S. 12-27
United States Tobacco Co., Richmond, Va., U. S. A.

SPECIAL CHRISTMAS OFFER: On receipt of this coupon we will mail direct to you or anyone you name a $1 or $2 box of Old Briar Tobacco. In case you want to make more Christmas gifts send names and addresses for each gift—also send your card if you want it to go with your gift.

Print Name_____

Address_____

City and State_____

Send the coupon now, with bills, stamps or check. Insure Old Briar's arriving in plenty of time for Christmas.

TO DEALERS: *Old Briar Sizes—25c, 50c, $1 and $2—air-proof and sealed. If your jobber has not supplied you, write us and we will send you a supply by prepaid Parcel Post at regular Dealer's prices. Every size of Old Briar has our unlimited guarantee.*

UNITED STATES TOBACCO CO., RICHMOND, VIRGINIA, U. S. A.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

ATKINS SILVER STEEL SAWS

Announcing The NEW METEOR

Introducing
A Light Weight
"Silver Steel"
"Segment Ground"
Cross Cut Saw

A Triumph

for ATKINS steel laboratories resulting in a better "Silver Steel"—a victory for ATKINS craftsmen in a great development of "segment grinding"—makes possible the introduction of this new light weight cross cut saw.

Records in winning three great championship sawing contests prove what we have discovered in actual service—that the new "Meteor" is the fastest cutting easiest running cross cut saw.

AT YOUR HARDWARE DEALERS you can learn how ATKINS is offering you the latest developments in saws and greater savings in sawing wood, metal or any other material. Look for the ATKINS name on the blade. Ask your dealer or write—

E. C. ATKINS & CO.
Established 1857

Leading manufacturers of Highest Grade Saws for Every Use; Saw Tools, Saw Specialties, Plastering Trowels, Machine Knives, Grinding Wheels and Files.

INDIANAPOLIS
U. S. A.

Using the Vee

(Continued from page 117)

the two milled openings, and a threaded hole for the holding screw. The vee is in the shape of a cylindrical piece snugly fitting the bore and seating against a shoulder in the end of the latter. Standard drill-bushings of the same diameter as the hole in the vee-block are used to guide the drill and are held against the work by the regular holding screw, which also clamps the work. The broad foot provides a ready hold for mounting the jig on the drill table. With the jig hardened and the bore ground, this little device makes a very accurate and durable article, which will pay for itself many times over.

A larger centering device designed to be used for drilling and boring in the chuck or on the faceplate of a lathe is that shown in Fig. 10. It is made from a cylindrical piece with the profile of a standard vee-block milled out in order to allow the use of regular vee-block clamps. A hole slightly larger than the largest diameter it is expected to bore is formed concentric with the outer surface, and the vee-groove is placed exactly diametral to these surfaces. Because of its shape, this holder can either be held in a lathe chuck or lined up on the faceplate, the ears left by the milling giving ample footing for the clamps. It will take careful work to get the vee centered on the holder and true in every way, but the time and care expended in getting

Here is a universal tool that performs many functions in drilling, milling or boring plain or shouldered round work. Note the holding fingers—firm but not in the way of the cutter

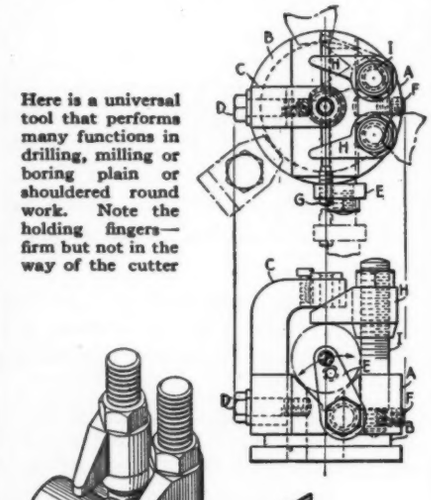


FIG. 12

this right will be found to pay well, as the work is automatically aligned whenever the jig is placed on a three-jawed chuck, or indicated from the center hole.

As in the case of other vee devices, work of two diameters can be supported by the use of blocks placed under the smaller diameter and against the sides of the groove. With the vee of Fig. 10 held in the *(Continued on page 119)*

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POPULAR SCIENCE MONTHLY
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Using the Vee

(Continued from page 118)

three-jaw chuck, off-center boring to a predetermined amount can also be done by a variation of the same method. In the case of a difference in diameters only, the thickness of the blocking used will, of course, be equal to that of the difference in the radii of the work. In boring off-center, however, the thickness of the blocking will have to be 1.414 times that of the desired off-center distance. Parts which must be supported on two different diameters and offset at the same time will require two raising blocks under the smaller diameter, and a block on one side of each diameter equal to 1.414 times the offset, as shown in Fig. 9.

THE usefulness of this particular jig does not end with its application to the faceplate of the lathe or the table of a drill. Fig. 11 shows it used in connection with a miller vise on a job requiring the formation of a slot or surface in angular relation to the axis of a cylindrical piece. Anyone who has ever tried to do this with ordinary equipment will understand the difficulties of such a job, when a number of duplicate pieces must be handled. The holder is pivoted in a special jaw in the miller vise. In the February 1927 number of POPULAR SCIENCE MONTHLY the writer described such a jaw for holding various centering devices. Where a jaw of this kind is on hand, it can be readily used in the set-up illustrated. Otherwise one will have to be made, but even this will not be a great deal of trouble. The pin should be a light driving fit in the vee-holder and a turning fit in the jaw, where it can be locked by tightening the set screw. The inclination of the work can be determined by the use of a protractor, which, once set, will remain undisturbed for duplicate pieces.

Rapid manipulation, as well as positive location and a powerful three-sided grip on the work, are advantages of this manner of holding. The rounded shape of the jig also permits maximum space for the cutter, no projections being in the way as in the case of a square block, which would be difficult to maintain at the desired angle. If intended to be used regularly for this kind of work, the bottom face of the holder may be made with graduations and the miller jaw with a corresponding central mark, so that the holder can be set without the use of a protractor.

THE devices so far described have been of the simplest nature, and while they are highly useful and have a comparatively wide range, they cannot be termed universal. In Fig. 12 is shown a vee fixture to which this appellation may rightly be applied. This versatile and yet simple device may be held in the lathe chuck or on the faceplate for boring larger holes. By removing the two upright posts, it may be used in the miller vise as described in the preceding paragraph. It is fully equipped for jig drilling, both center and off center, and to predetermined lengths, (Continued on page 120)

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Using the Vee

(Continued from page 119)

and it is particularly adapted for handling work of several different diameters, both in connection with the drill-jig feature and for boring.

The jig consists of the main body A, made from a length of heavy round stock, the outer surface, bore and vee-groove being related to each other as in the last described holder. A deep groove B, near the bottom of the shape, serves as a footing for the clamps used in holding the jig to face-plate or drill table, but the generally cylindrical shape also allows it to be held in either a three-jaw or a four-jaw independent chuck. To one side of the vee a deep slot is milled lengthwise of the body to form a seat for the drill-bushing arm C, which is clamped in position by a single cap screw D fitted with a pressed-on washer. From the construction of the bushing holder, it will be seen that the latter can almost instantly be removed or placed in position, adjusted for height, and clamped. This is important when using the jig for boring, as well as in arranging the work for drilling from the jig later on.

THE same construction renders particularly easy off-center drilling by predetermined exact amounts. All that is necessary is to place a shim of a thickness equal to the required off-set between the shank of the bushing holder and the bottom of its groove. For the drilling or boring of duplicate pieces to a uniform longitudinal location, a length gage E is provided. This gage can be swung in a semicircle, pulled out, and locked in any position by a clamp screw and brass plug F. Two holes are provided for the registering screw G to allow for work of varying height and diameter.

A feature of the greatest importance are the two work-holding fingers H. By reason of their shape and position, they combine the advantages of being always at hand and never in the way. Slidably mounted on the two heavy threaded posts I, they can be quickly adjusted to any angular position and any diameter within the range of the jig, and when tightened down, hold the work in a firm grip. The shape of these fingers is such that they leave a maximum unobstructed space around the point where the cutting tool is to work. Even when pushed closely together, they allow the bushing arm to be adjusted to within a short distance of the work, and with their points separated an inch or so, the bushing can be brought right down on to the part to be drilled, an important advantage.

NOVEL features are the insert vees, of which two are in use on the part shown in the illustration. These inserts are not difficult to make and it will pay to have a few of them on hand. For small differences in diameter, such vees can be made in a few minutes by bending a piece of sheet metal of the required thickness at right angles, as shown in the illustration. Hardened blocks should be used in doing this and care must be taken to get the surfaces perfectly flat and at right angles to each other.

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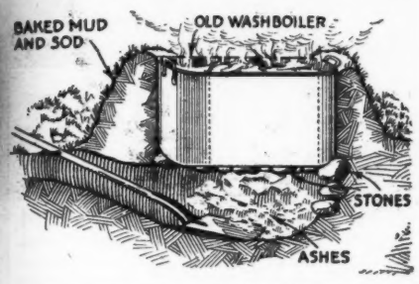
The Shipshape Home

Back Yard Incinerator

INCINERATORS manufactured from heavy wire, concrete or sheet metal are often unsightly, and wire basket burners in particular permit small rubbish to fall through and litter up the ground. Without expense one can make a baked



Cutaway view of an outdoor incinerator which is both efficient and inconspicuous

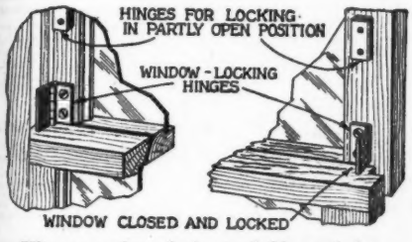
mud affair that is as efficient, yet is not offensive to the eye.

An old washboiler with the bottom knocked out supplies the form and lining. Build mud up around this gradually, letting each trowel full become firm before adding to it. Then put on strips of sod and keep them sprinkled until the roots take hold on the mud base.

In California this type of incinerator survives the heaviest rains. The good draft provided burns up all debris and the ashes can be removed and used for fertilizing lawn and gardens.—HI SIBLEY.

Locking Windows

CHEAP, strong window-sash locks may be made as shown from small brass hinges, preferably nickel plated. Screw one on each side of the inside face of the upper sash with the bottom of the hinge in line with the top of the bottom sash and the hinge joint close to the parting strip in the window frame. To lock

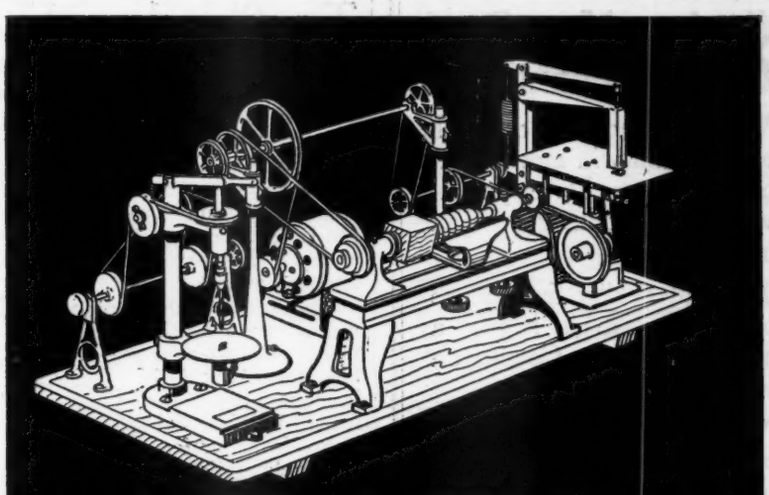


Hinges used as locks to hold a window either partly open for ventilation or closed

the window, open the hinges. When the hinges are shut there is generally room enough to let the sash pass each other, but if not, countersink the hinges.

Should you want to lower the top sash or raise the bottom one to let in air and still have them locked, put on two more hinges, say 3 in. higher.—T. JEFFRIES.

WHEN A hack saw breaks near one end and another blade cannot be obtained immediately, heat the broken end to draw the temper, drill a hole in it, and replace in the frame.



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Study the specifications of this ultra-quality line of dependable machine tools, selling at prices you can afford.

You can easily see the great advantages of owning an outfit like this. It can accurately handle the small turnings and do saw work, that now take so much time doing by hand on ship models and other work, and at the same time it is big and sturdy enough to handle up to ⅜" lumber in the saw, turnings 2⅜" x 5" and will drill not only wood, but metals (iron, copper, brass, lead, aluminum), bakelite, celeron, slate, radio panels, etc.

It has been especially designed so that it can do not only the ordinary work but very small work as well.

It is operated by ⅓₅ h.p. 110 volt a.c., d.c. motor, the cutting tools are the best tool steel, the drills and saw blades of high temper. Coming with the outfit is your first piece of wood for turning, wood stamped with design for sawing, and illustrated instruction book, belting, and all tools.

Outfit comes completely set up, ready to plug in to an electric light socket. Motor costs less to run than a 75 watt lamp. Or, you may buy any of the tools separately.

This outfit is a worthy addition to any work room, and is handy in a hundred ways.

WORKSHOP No. 990 $27.50
Complete
Denver West $30.00

Go to your dealer and see a Knapp Work Shop—hardware, sporting goods stores, or department stores (toy dep't usually), or send 10c. in stamps for full color catalogue fully describing Knapp American Industry in Miniature.

If your dealer is out of stock we will send for price plus carrying charges.

Knapp Jig Saw No. 900
Capacity up to ⅜ in. lumber, also bakelite, celeron, etc. Handy for making radio panels, as well as jig saw and scroll work. Instruction book, wood with design laid out ready for cutting and 3 blades furnished.
$4.00 Denver West $4.25
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Sample of work done on Saw No. 900 from Outfit 902 which consists of 20 boards, 4 ½ x 12 x 3/16 in. and 12 designs for making everything from toys to practical household articles.
Outfit 902, $2.00
Shipping Weight 6 lbs.

Knapp Speed Drill No. 910
Takes 1/16 in. to 3/16 in. dia. drills. Drills wood, iron, copper, brass, aluminum, lead, slate, bakelite. No workshop, whether you work wood or metals, complete without one. Instruction book.
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The large Re-Set Revolution

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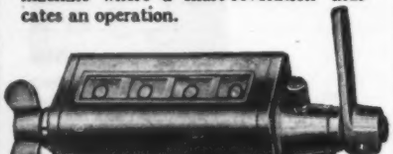

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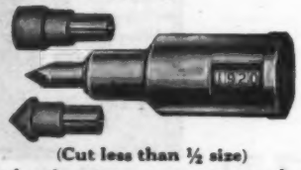

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The Shipshape Home

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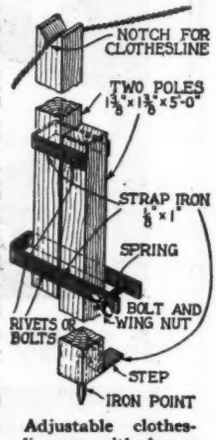
The materials needed are two pieces of wooden baluster stock 1⅜ in. square and 5 ft. long; 1 piece of strap iron, preferably galvanized, ⅛ by 1 by 25⅝ in.; one ⅜-in. bolt 2½ in. long with a wing nut and another ⅜-in. bolt 4 in. long; a coil spring 2¼ in. long, of a diameter to fit over a ⅜-in. bolt; six ¼-in. bolts 2 in. long or rivets.



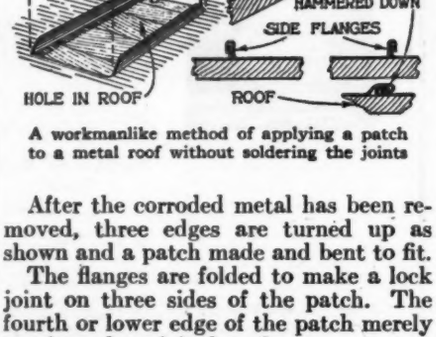
Adjustable clothesline prop with clamps

Cut the strap iron into three pieces, 11⅝, 10, and 4 in. long respectively. Drill, bend and assemble them as shown. Cut or grind off the head of the 4-in. bolt to make a point for the prop. Note that the closed end of the larger of the two clamps or straps is allowed to project 2¼ in. beyond the wood as a hand grip.

To use the prop, stand it under the clothesline in a vertical position, take hold of it with the left hand at the upper clamp, place one foot on the foot rest, and pull up the lower clamp with the right hand. Then screw the wing nut tight.—JOHN BELL.

Patching Metal Roofs

WHERE a section of a slanting metal roof has been eaten through by corrosion and the remainder of the surface is in such good condition that it does not need renewal, the damage may be repaired by applying a patch as illustrated.



A workmanlike method of applying a patch to a metal roof without soldering the joints

After the corroded metal has been removed, three edges are turned up as shown and a patch made and bent to fit.

The flanges are folded to make a lock joint on three sides of the patch. The fourth or lower edge of the patch merely overlaps the original roofing.

Several coats of good roofing paint should be applied over the patch and around the edges.—G. A. LUERS.

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A 2c Stamp

—will start you on the road to success. See Money Making Opportunities on pages 146 to 174.

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Building Airplane Models

Standard Types—Tools and Materials Needed

By J. Danner Bunch *and* Avison F. Koch

TO FLY airplane models that you have built yourself is thrilling sport. You can hardly imagine the fun it is until you have tried it. The take-offs, the flying and the landings are all of breath-taking interest. Even more so is the participation in the airplane contests conducted by many model airplane clubs.

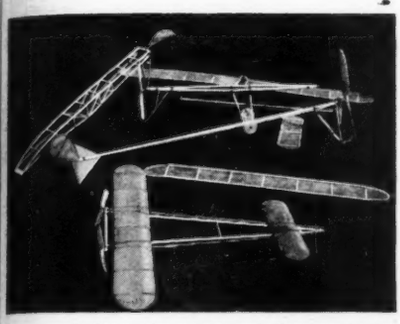


Fig. 1. Twin-pusher racing model (in foreground); single surface wing panels; fuselage for hand-launched tractor; girder fuselage for "R.O.G." pusher with geared propeller intended for three motors and double surface wings of 36-in. span; R.O.G. pusher (in rear)

At the outset it is well to familiarize yourself with the standard types of airplane models which are flown in contests and made by the majority of experienced model makers.

The simplest of all is the pusher plane with a single propeller (Fig. 2). It is usually a tiny ship with wings 2 ft. across and a stick for its body, or fuselage. It has no undercarriage and is launched from the hand.

The tractor plane with a single propeller in front is

(*Continued on page 124*)

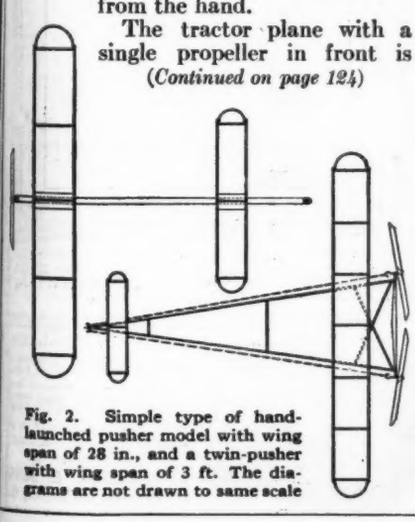
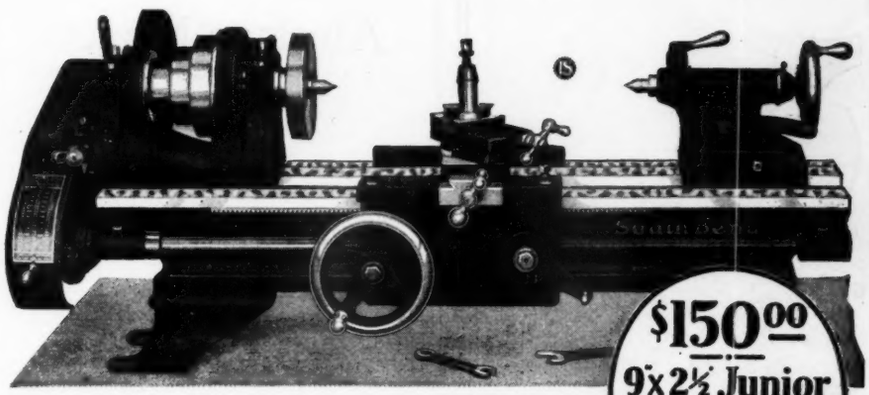


Fig. 2. Simple type of hand-launched pusher model with wing span of 28 in., and a twin-pusher with wing span of 3 ft. The diagrams are not drawn to same scale



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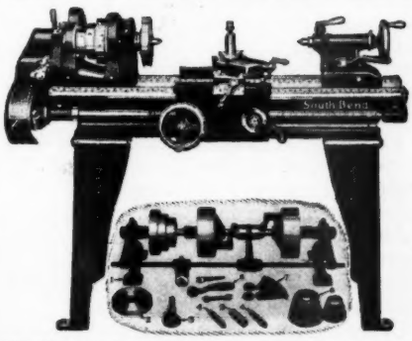

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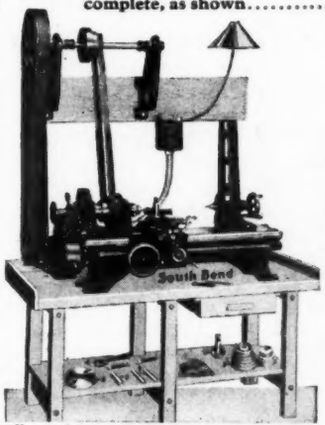

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Airplane Models

(*Continued from page 123*)

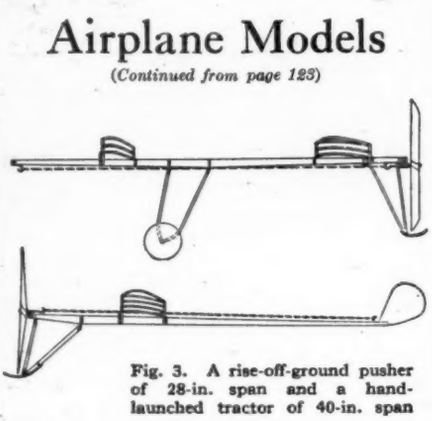


Fig. 3. A rise-off-ground pusher of 28-in. span and a hand-launched tractor of 40-in. span

another model easy to build and offers interesting possibilities. One of these is illustrated in Fig. 3. The writers have seen these in various designs and sizes, some 6 ft. across, and have witnessed wonderful flights made by them.

The most remarkable flier of all is a twin-propelled pusher (Figs. 1 and 2). Some of these will fly a mile, and the writers have seen flights of two miles.

Although these models are of the hand-launched type, they may be equipped with pontoons for taking off from and alighting on the water.

Other models shown in the accompanying diagrams are a rise-off-ground (commonly written "R.O.G." by model makers) pusher (Fig. 3), a geared R.O.G. tractor (Fig. 5), and a tractor model with compressed air motor (Fig. 6).

Beautiful models can be constructed that resemble full size airplanes in flight, such as the flying model of Lindbergh's plane described in October. Incidentally, a blueprint can be obtained for that plane—No. 69 in the list on page 102. Carefully designed and constructed models of this type can sometimes be flown under favorable conditions for half a mile. Their take-offs and landings are most realistic.

PREFERRED SHAPE OF BLADES FOR CARVING PROPELLER

Fig. 4. Knife and plane used for model making

The models driven by compressed air motors of the rotary or stationary type are the most elaborate ordinarily built. The writers have seen excellent flights by a 6-ft. monoplane with its two-cylinder motor turning at terrific speed and buzzing like a giant bee.

The materials for model building are inexpensive and only the simplest tools are necessary. A good assortment consists of a small (*Continued on page 125*)

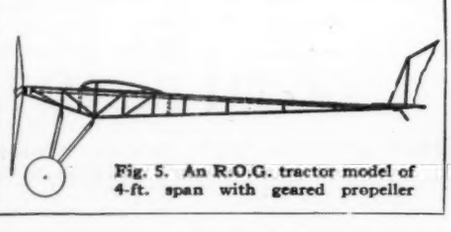
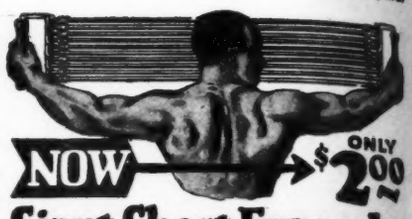


Fig. 5. An R.O.G. tractor model of 4-ft. span with geared propeller



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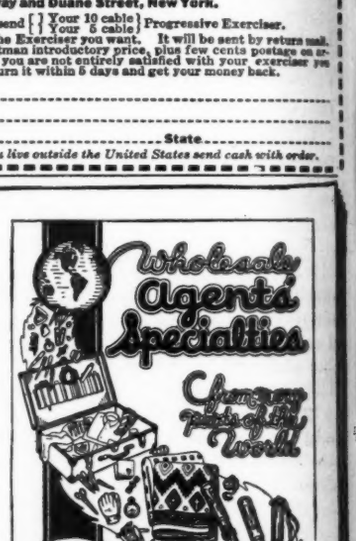

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Airplane Models

(*Continued from page 124*)

bench vise with 2-in. jaws, a hand drill with 1/32, 1/16, 3/32 and 1/8 in. twist drills, a light claw hammer, a small triangular file, ruler, a pocketknife for carving propellers, a 1-in. block plane (see Fig. 4), a pair of small, long-nosed pliers with side cutters, and a pair of shears.

All necessary materials can be obtained from dealers in model airplane supplies. For wing spars, longerons and braces, one can obtain white pine from any planing mill and cut it or have it cut on a small

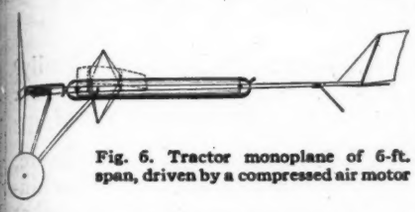

Fig. 6. Tractor monoplane of 6-ft. span, driven by a compressed air motor

bench saw to the required dimensions.

Ribs, skids and outline pieces are best made of bamboo. The most desirable quality of bamboo for model making is to be obtained from the model supply houses; that is true also of rattan for undercarriages. These dealers also sell bamboo paper for covering wings, airplane wing varnish, commonly called "dope," rubber for motors, and, of course, all sorts of ready-made accessories and tools. Silk thread, china silk, glue, bicycle spokes, piano wire, spool wire, brads, pins and washers are easy to get.

If there is no model club in your own locality, you will find it a simple matter to organize one.

Races can be held to determine the best designs and construction. Tests for distance are always measured in a straight line from the starting point. Duration contests are held to see which model can stay aloft the longest.

It is important, of course, to classify the races carefully as to pushers and tractors, and rise-off-ground and hand-launched models. The fairest rule for any test is to allow each entrant three flights in each event and count the best one.

The charter members of the club should formulate rules to govern races and the admittance of new members. A condition should be laid down that new members are admitted for a limited period and can become regular members only when they have constructed and flown a model that conforms to the club's regulations.

AN ARTICLE in the January issue will give a number of hints in regard to the construction of standard models.

If you wish to start building immediately you will find complete instructions in the March, 1925, issue of POPULAR SCIENCE MONTHLY *for making a simple pusher model with twin propellers something like the racer shown in Fig. 2. An article on the construction of an R.O.G. tractor monoplane, designed by Mr. Bunch, was published in September, 1926, and one on a 3-ft. flying model of Lindbergh's plane in October, 1927. These back issues can be obtained as long as the supply lasts for 25 cents each. Supplementary blueprints are available for the tractor monoplane and the Lindbergh model. They are Nos. 50 and 69 in the* POPULAR SCIENCE MONTHLY *series. See the coupon on page 102.*

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How I Made a Desk

(*Continued from page 81*)

through a bit. This is a filler coat and the only way to make a perfectly smooth surface is to rub enough to cut off the high points of the surface. Apply a second coat in the same way and rub it lightly with No. ½ paper.

On this desk the next coat was white lead ground in oil, thinned with turpentine only and tinted with a very little medium chrome green and a little raw sienna, both colors ground in oil. The color was light pea green. One coat was applied and allowed to dry twenty-four hours. It was sandpapered lightly with No. ½ paper. Another coat of the same paint was applied after adding dry whiting to it, a handful to a quart of paint.

THE object of adding whiting is to enable you to stipple the paint to a fairly rough surface. The second coat is put on a bit thicker and while wet is pounded all over with a stippling brush as in Fig. 3. This is a brush 4 by 8 in. with very long bristles. Any long bristled brush or a flat wall brush, preferably of the 4-in. width, can be used to stipple paint. It must be used like a hammer, however, to pound the surface with the ends of the bristles. The normal stroke, from side to side, will not do it. Allow this coat to dry two days.

The glaze-stain is simply a mixture of raw umber, ground in oil, and turpentine. Raw umber is a semitransparent color and for a glaze should be mixed thin. Brush it over the stippled surface fairly evenly. While wet take a wad of cheesecloth and wipe the glaze in vertical stripes as noted in Fig. 4. Allow the fingers to bear down hard to make the streaks. Try it once or twice for practice. Then wipe off and make a clean start and a clean finish. The stripes usually run the long way of the surface, as on the sides, but on the base molding they were drawn horizontally.

In the glazing process you will see the advantage of having stippled the undercoat. The glazing color sinks into the deep pits and is removed only from the high points by the wiping. This produces a two-tone finish. The method may be done in any color combinations wanted as long as you use semitransparent colors such as (*Continued on page 131*)

Decorating Gifts

(*Continued from page 74*)

object and twirling until the entire inside is colored; the excess lacquer is then poured out. By pouring in two colors, a unique streaked effect is obtained. The pour finish is not wasteful; surplus lacquer is poured back into the can. Vases so decorated cannot be used for flowers; standing water may loosen the paint.

Spraying allows the amateur to produce many shaded and stippled effects. Inexpensive sprayers for the purpose are sold by some paint dealers, and an ordinary insecticide spray gun may be used.

Regular brushing lacquer may be sprayed quite satisfactorily with this equipment by reducing it from ⅕ to ⅓ thinner, which must, however, be made by the same manufacturer as the lacquer. Some practicing should be done to learn the manipulation of the sprayer, and the spray should be used rather cautiously.

Frosting is a pleasing effect, which may be obtained by blowing gold, aluminum, green or copper bronze powder from a paper onto an enameled or lacquered surface while it is still wet. On a lacquered surface it is necessary to work speedily before the quick-drying lacquer commences to set.

Texturing colored prints is another new idea. Fine prints such as are found in magazines or bought at a nominal cost can be given an appearance closely resembling that of an oil painting.

Lay the print, picture side up, on a clean, perfectly level surface, and place a piece of cheesecloth over it. (*Continued on page 134*)

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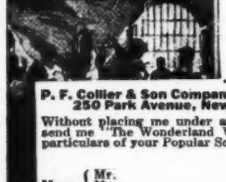

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Restoring Antiques

(*Continued from page 86*)

little crowning (convex) in the center to avoid digging in with the corners. If places are found that are still hard, do not dig at them; pass them over and apply another coat of remover.

For carving, fluting, beading and fine moldings, use a stiff bristle brush, but not a wire brush. From turnings such as chair rounds, posts, columns and spool beds, remove the softened finish with coarse burlap, using the same method employed by a bootblack in shining shoes.

IF, AFTER the first operation with remover, the surface seems to have retained some of the old coating, apply another lighter coat of remover and rub off in about five minutes with steel wool (not coarser than No. 0). This is always necessary with carvings and turnings, and sometimes must be again repeated.

The corners and very close places will be found still to contain the loosened varnish and steel wool. Don't scrape or scratch this out with metallic instruments, but make the necessary tools from pieces of hard wood sharpened to a chisel edge or pointed, and covered with cloth. Move from one part of the cloth to another as it becomes foul.

To clear the wood from all remover, rub well with turpentine, benzine or gasoline, preferably the first. A cheap substitute for turpentine, satisfactory for this purpose, is what is often called petroleum spirits.

If it should be found necessary, after the old finish is removed, to do scraping, first apply a coat of pure kettle-boiled linseed oil, diluted with an equal part of turpentine. Let this dry into the wood and it will be found that not nearly so much scraping is necessary.

WHEN buying varnish remover, be sure to obtain a high grade product made by a reliable manufacturer. It is not difficult to make your own remover at about one third the cost of first-class prepared removers, but do not attempt it unless you know how to heat highly inflammable liquids and are prepared to take all possible precautions against fire. For making an excellent remover, use 3 pints each of benzol, acetone and denatured alcohol and 1 five-cent cake of paraffin wax. Heat the alcohol as hot as possible in a double boiler, and add the wax, shaved fine. Mix the benzol and acetone cold and heat to a point sufficient to melt wax. Pour the ingredients into one container and shake them well. Then let the remover cool. Always shake well before using. More or less may be made by increasing or decreasing the amounts proportionately.

No filler of any kind is needed after an old finish has been removed, neither is stain required. The proper finish for an antique, in my opinion, is the natural wood.

Any necessary repairing, patching and gluing should be done before the old finish is removed. These and the methods of doing the final finishing will be discussed in future articles.

What causes the patina is an interesting subject. According to the Forest Products Laboratory of the U. S. Department of Agriculture, it seems probable that it is a change in the physical condition, possibly resulting from a photochemical reaction, in the part of the wood that is near the surface.

TO FASTEN light removable fixtures to a cement wall or floor is not difficult. Obtain some wire that is about equal in diameter to the pitch of the threads on the bolts to be used and wind a length of wire around each bolt in the threads. Drill holes in the concrete, place the bolts and pour cement around them. When the cement is hard the wire will be held firmly and the bolts can be removed or replaced.

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For "B" Eliminators and Amplifier Circuits. Made in 2.5 and 5 watt sizes in ranges from 500 to 100,000 ohms.

Adopted and Used by Leading Radio Manufacturers

Philco	*Kokomo Electric*
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Made in ranges from 500 ohms to 10 megohms. Standard or Special tips.

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RESISTORS & POWEROHMS

INTERNATIONAL RESISTANCE CO., 2½ S. 20th St., Dept. T, Phila., Pa.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

LEAVE IT TO THE YOUNGER CROWD TO KNOW THE BEST!

IT is characteristic of this younger set to settle the cigarette question exactly as they settle their hard-fought games — on the sporting principle of "may the best win!"

FATIMA

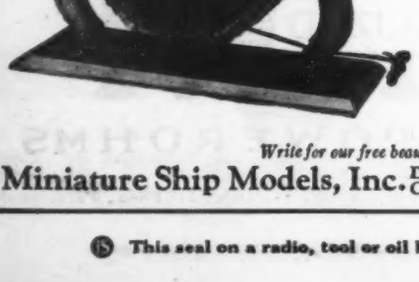
A few cents more—for the best that money can buy!

LIGGETT & MYERS TOBACCO CO.

MAKE MORE MONEY READ MONEY MAKING OPPORTUNITIES ON PAGES 146 TO 174 OF THIS ISSUE

A NEW RADIO LOUDSPEAKER

This Dual Tone Speaker Reproduces the High and Low Notes Perfectly. *Build It Yourself for* $12.50



The COMPACTCONE is a thirty-inch cone speaker, so arranged that it fits into a cabinet fourteen inches in diameter and seven inches deep. It has two distinct sound chambers, one being designed to reproduce the high notes and the other to carry the low notes of the tuba and the bass viol. It is damp-proof and cannot be affected by weather conditions.

The usual thirty-inch cone, while possessing wonderful tone value, occupied so much space that it is considered impractical. In the COMPACTCONE the diaphragm is full thirty inches but it is so arranged as to occupy a space but fourteen inches in diameter.

The COMPACTCONE may be had in the completed form and in knock-down kits. In the knock-down form we supply all the necessary parts, cut to fit and ready to assemble, with full directions for assembling. You can put one together in a very short time.

Write for our free beautifully illustrated catalog

Miniature Ship Models, Inc. Dept. PS, 3818-20-22-24 Baring St., Philadelphia, Pa. *Canadian Branch: 1485 Bleury St., Montreal, Canada*

Paper Models Help Design Stage Settings

(*Continued from page 92*)

to be used should be rather heavy and stiff. Cardboard is almost too thick for convenient handling; besides, the folded edges are apt to crack and open up. I have found that in general a gray or light brown "cover paper" is most useful; it will take water color and with the use of tempera, or "showcard" colors, substantial effects can be obtained which suggest the finished sets far better than the use of the ordinary water color washes.

Windows and door openings can best be cut with a sharp penknife over a sheet of glass. The window divisions can be suggested with string or heavy thread fastened across the window openings, on the back of the drawing, by means of narrow strips of sticker tape. It will be well for the scenewright to keep handy a roll of this paper fastening-tape, the kind that is now generally used in stores for the binding of packages. This paper is more useful than paste, not alone for joining sheets of paper, but also for securing the side walls of the model to its base or floor.

If your set calls for a backdrop, a country or city view seen through a window, and if the scenewright is unable to make the sketch himself, he can usually find among the advertising pages of magazines suitable colored pictures. Sections of these will answer for the backdrop of his model and may also serve him later as a suggestion for the actual backdrop. Colored post cards are also useful as views from small window openings.

In fact, the scenewright after only a little practice will invent for himself all manner of ways of making his small models look like miniature rooms. He will find that tables and chairs can be cut from paper and folded into lifelike imitations of the real thing. And later on, when the actual sets are built and he sees them through the proscenium arch, they will offer him no shocking surprises in the way of omissions and accidental misfits, but instead he will be looking into a now familiar room, and recognize it as his own model grown up.

Wood Filler Gives Two-Tone Effect

THE use of light or aluminum colored paste wood filler to obtain a weather-beaten or silvery finish on oak and other open grained woods is well known to many home workers, but few amateur painters and decorators realize that many other novelty effects may be obtained in a similar way.

For example, chestnut or oak may be colored with a light oak stain and then filled with paste wood filler tinted a dark blue. A dark oak stain may be used and the filler tinted with Venetian red, or a forest green stain, followed by a gray filler made by mixing white lead and a minute quantity of lampblack with the paste filler.

In all cases it is best to use dry pigment to color the filler, which should be applied and rubbed off across the grain, just as if it were in its natural color.

After the filler has dried for 24 hours or more, it is given a coat of thin shellac and may be followed either by varnish or wax.

IF A DOOR BINDS on its front or lock edge, do not plane the finish off. Instead, take the door off the hinges, remove the hinges, and plane enough off the back or hinge edge to allow the door to swing freely. Then cut an equal amount from each hinge bed and rehang the door. Perhaps the hinge joint may be open enough so cutting the hinge bed will be sufficient. If planing is necessary, finish the back edge of the door and no one will suspect that a piece of repair work has been performed.

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The True *Santa Maria*

(*Continued from page 82*)

companion adventurers might well be hung on the palisades. Thus, although we are not going to make a seventeenth century, brand-new carnival kind of ship, ours will be equally beautiful, if not more so, than the usually accepted model.

After exhaustive research, the writer believes his model is of a ship such as Columbus might, and probably did, use in making his famous voyage. No smallest detail or touch of color has been embodied without reason. For example, the shade of the blue used on the loopholed bulwarks is not there because it is pretty, but because it is the blue that was used on ships for centuries, and is still to be found in the flags of Catholic countries, as the "blue of the Virgin's robe."

HAVING given my reasons for this *Santa Maria*, instead of the all too common one usually seen, we may get to work, feeling confident that the result will more than compensate for the time and care involved. The model looks complicated, but if the plans and instructions are followed and troubles are not anticipated, it will be found to work out quite simply.

Full size drawings are essential, but these you can obtain by sending for POPULAR SCIENCE MONTHLY blueprints Nos. 74, 75 and 76. Use the coupon on page 102.

The tools required will be the usual domestic kit, with, in addition, a fret saw, spokeshave, half-round file or rasp, small round-nosed and cutting pliers, some small C-clamps or spring clothespins, a light hammer, small nail set, tweezers, and some very small wire twist drills with a handle. A set of die-sinker's files are useful, as is a jeweler's saw.

The material needed will be referred to as the work proceeds. Little need be bought excepting the pine for the hull, the reed spline and a few dowel sticks, with cord, wire and canvas for the rigging; indeed, five dollars should cover all the material. A complete bill of materials will be found on Blueprint No. 74.

The hull is made of a series of layers or lifts, so first we must have full sized drawings of each of them. These may be enlarged from the plans given in Fig. 1, but Blueprint No. 74 gives them all drawn to the full size required for a model with a 19-inch hull and an overall size of 23 in. long and 21 ½ in. high.

Clear white pine is the best wood. One board ½ by 5½ in. (nominally 6 in.) by 15 ft. 6 in. will be sufficient. On this draw the outlines of the lifts A to N, of which A to F extend the full length of the vessel. G, H and J are short pieces at the bow, and those from K to N are half-length lifts at the stern end. It will also be noted that the hull is at its widest at lift E, and from there "tumbles home," or narrows, as it rises, nearly all its midship length.

ON EACH lift, before cutting, mark the midship line and the necessary cross lines (I to VIII), extending them over the edges. With the fret saw or hand saw and spokeshave, cut each piece to size. To reduce the weight and make the hull less liable to warp, lifts B to E may be hollowed to within ¼ in. of the outline of the lift immediately below. Lifts G, H, K also may be hollowed. Glue together lifts A to F, being careful that the construction lines coincide. Leave this block clamped or heavily weighted for a day.

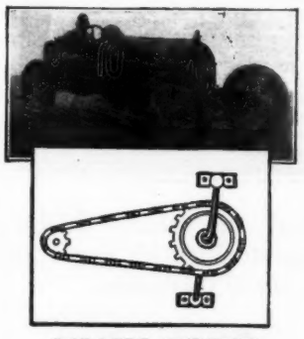
From a piece of cardboard cut a series of templates to the lines of the bow and stern profiles (sheer plan) and to the body lines (body plan), marking on each where the lower edge of lift E cuts them.

Cut away the projecting corners from the block until the bow and stern templates fit it at the ends. Shave down the center of the top to the deck line, (*Continued on page 130*)

This wonderful new SPEEDMOBILE makes you a faster racer than you ever dreamed!

YOU'LL leave the bunch way behind when you step into this speedy little racer. The Speedmobile boy is always the envy of the neighborhood.

This shiny red speedster has real class. It is built just like an honest-to-goodness racer, slung low, balloon tires and everything. Not only is it a winner as a racer but it coasts too. Simply keep the pedals still and let 'er go! Has the famous patented "Speedorcoast" sprocket, that speeds ahead, reverses, brakes and coasts.



CHAIN DRIVE
like famous racing cars

THE new Speedmobile chain drive is the greatest improvement ever made in boys' automobiles. It has a chain sprocket like famous racing cars with bicycle-type rubber cushioned pedals. It's a cinch to win with this new snappy racer. It is adjustable for boys from 4 to 10 years old.

SAFE *because under control*

THE Speedmobile has double precautions for safety. Besides an emergency brake the boy's feet are always free to act as brakes because his legs aren't enclosed by side boards. The chain is guarded too, so he can't possibly catch his legs or clothes in it.

Send for FREE *racing poster*

BOYS, send for your free Racing Poster in colors. It tells all about the Speedmobile, the famous "Sunbeam," the fastest car in the world and lots of other automobile information. Send the coupon for it today. You'll enjoy it. It's a gift from the Children's Vehicle Corporation to you. Address Children's Vehicle Corporation, Dept. E-1, East Templeton, Mass.

CHAIN CVC DRIVE SPEEDMOBILE

$19.75

FASTEST JUNIOR BUILT

West of the Mississippi, $21.50

MAIL THIS COUPON

CHILDREN'S VEHICLE CORPORATION,
Dept. E-1, East Templeton, Mass.

Please send me a free copy of your Racing Poster.

Name.....

Street.....

City.....*State*.....

I am.....*years old, going on*.....*years.*

30 Days Free Trial

Just Out—1928 Model

One Dial RADIO

Yes, Sir! You can put any new 1928 model WESTGALE Radio in your home and use it to your heart's content on 30 DAYS' TRIAL.

Listen to the music, concerts, news, sports, market reports from stations all over the country. Test it for distance, selectivity and REAL tone value. Compare it for quality and price with any Radio you ever saw or heard. Then if not convinced that Westgale gives you the biggest value for the money—*You Don't Have to Keep It.*

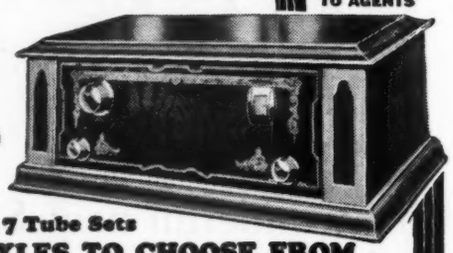
5-6-7 Tube Sets $47.99 to $72.99 RETAIL PRICES

BIG DISCOUNT TO AGENTS

Send for FREE CATALOG Before You Buy

Now Westgale offers you the last word in Radio at lowest prices. Our new Superphonic Tone System gives amazing reproduction. One dial control with illuminated dial and shielded construction puts Westgale sets years ahead in powerful reception and better tone quality. Our retail prices are low factory prices. Agents' prices are even lower.

Westgale (S)



Retail Price $87.00 6 tubes, 1 dial Completely Assembled Including Loud Speaker

5 Tube
6 Tube and 7 Tube Sets

24 STYLES TO CHOOSE FROM

This season Westgale offers almost any size or style of Radio you could wish for in a beautiful array of table styles, consoles and latest de luxe period type cabinets. Thousands of Westgale Sets have been sold on this 30 Day Trial Plan. Why pay high prices? Why take chances when you can test any Westgale model in your own home on 30 Days' Trial?

Your Own Radio FREE
Our new Catalog also explains a plan whereby you can put a Westgale Radio in your home on 30 Days' Trial—demonstrate it to your friends in your spare time and get your own set without cost. Send for the catalog.

Why Not Be Our Agent?
Why not get Demonstrator set on 30 Days' Trial and make big money in full or spare time? Big discount off retail prices to first Agent in each community. Be first. Write today for special agent's prices.

Don't buy any Radio until you send for our new FREE Catalog and 30 Day Trial Offer

WESTGALE ELECTRIC COMPANY
Dept. 3412 1751 Belmont Avenue CHICAGO, ILL.

Make More Money

Read the Money Making Opportunities on pages 146 to 174 of this issue.

FREE The Greatest RADIO CATALOG

Send for This Great Book

1928 WHOLESALE CATALOG of RADIO Sets, Kits and Supplies

Compiled exclusively for dealers in radio sets, radio parts, and for set builders. An Amazing Catalog containing the newest things in the world of radio.

Unbeatable values in Radio Parts, Kits and Supplies of National Fame. A complete array of cabinets and consoles, in all latest styles, finishes and popular sizes, at Unmatched Prices.

The high quality of our products eliminates loss. Large stocks offer you large selection. Our speedy shipments insure your customers' good will and bigger profits for you.

Real Bargains to Dealers

Wholesale Vest Pocket Price List and Discount Sheet
This wholesale vest pocket price list and discount sheet will be sent with the catalog.

SHORT WAVE SECTION
Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the finest electrical appliances for use in the home.

Shure Service means sure profits. You can take orders direct from our illustrated list price catalog.

Whatever your radio needs may be, you will find them in our 1928 catalog.

Write for a copy TODAY.

SHURE RADIO COMPANY
1421M West Madison Street, Chicago, Ill.

Yours for 10 DAYS FREE

$3 DOWN

Say the word and we'll send you a genuine L. C. Smith (world's only ball bearing typewriter) to test 10 days. All the latest operating attachments; beautifully rebuilt; GUARANTEED 5 YEARS. Sensationally priced; 40% saving; easy terms.

SEND NO MONEY

FREE Typewriting Course, Tools, Waterproof Cover if you act now. Write for Special Offer and free typewriter manual.

SMITH TYPEWRITER SALES CORP.
523-360 E. Grand Ave. Chicago

STEEL BLUE Elite Diamond
IF YOU CAN TELL IT FROM A DIAMOND SEND IT BACK!
$3.89 COD

1 Carat Elite Diamonds. Matchless for their dazzling rainbow brilliancy. You'll be delighted. Elite Rings Surpass all others. Stand acid and other tests. Handsomely Engraved Ring sterling guaranteed. Looks like $250.00. Proud owner offered $85.00 5 minutes after buying one. Collar and Cuff Links FREE. With each ring order, we give free beautiful Combination Set set with small Elite Diamonds. SEND NO MONEY. Just send name, address and finger size. On arrival pay postman $3.89 and postage. Satisfaction Guaranteed. Write today. Cash with Canadian or foreign orders.
Elite Jewelry House, Dept. 382, 609 S. Paulina St., Chicago, Ill.

MANUFACTURERS
If you have a machine that does not function properly we will redesign it or design a machine to increase your production and lower cost.

INVENTORS
We develop inventions, perfect ideas and build beautiful Models.
We Have a national reputation, a staff of high-class Mechanical Engineers, operate our own machine shop and guarantee entire satisfaction. Write us for further information.
R. G. CLYNE ENGINEERING CO.
3500 Easton Avenue St. Louis, Missouri

The True *Santa Maria*

(*Continued from page 129*)

and shave away at the sides until your templates nearly fit when held at their respective construction lines (I to VIII).

Glue on the bow lifts G H J and the stern pieces K to N. Note that the lower edge of L follows K upwards, but that the upper edge comes sharply out to coincide with piece M (see the body plan at line VIII). Piece M starts at line VI, and piece N ½ in. abaft line VIII. Cut the upper-deck-line sheer on these and then shape the whole up to the templates. If your lifts are cut properly to shape, this should be a matter of shaving away the projecting corners until you have a smooth surface with easy, flowing lines. The ends should be flat and ¼ in. across to take the stem and sternposts.

FROM ¼-in. wood, cut a keel, stem and stern. This is more easily made in three pieces, joined as shown. Glue and nail on these pieces firmly. Make a bracket for either quarter from ¼-in. wood as shown at O, cutting away the hull so that the forward, upright edge of these pieces is flush with the main hull. Glue and nail these in position.

To the line *q* cut a rabbet, a bare ⅛ in. deep, and to the line *r* along the stern do the same. Into these rabbets fit white pine bulwarks Q and R, ⅛ in. thick. Try these out in cardboard before cutting the wood. Glue and lightly nail them in position, then cut their top edges to the lines, making sure that both are the same height. Along the after part set in similar ⅛-in. strips R. Sandpaper all flush with the hull. The parts R extend forward over Q, ending in the one curve; clamp them together here until the glue dries, and reinforce, if desired, with a pin used as a nail.

Sandpaper the deck smooth and mark the deck planks with a very hard pencil. The lines should run truly fore and aft at about ¼-in. intervals.

Across the after bulkhead there will be an overlay S of any hard wood such as mahogany or cut from a cigar box. It should be as thin as possible. Mark or carve on it a center door flanked by windows. The latter can be cut right out and backed with pieces of celluloid or mica. This piece is glued and lightly nailed on. A similar piece may be made for the forward bulkhead, but will not show.

Similar overlays should be made to glue onto the poop sides T, each with six ¼ in. sq. windows, two between each of the four after skids. The photographs show them all the way along, but that may be too many and the drawings should be followed. Across the forward end of the after deck glue a thin strip to cover the joint, and along the after bulwarks a similar but wider strip, flush inside but projecting $\frac{1}{16}$ in. outboard.

ACROSS the stern is overlay U. This may be plain with the exception of two little doors. It is possible, however, that because Columbus named his ship "Santa Maria," one of his few friends at court may have given him a painting of the Madonna, which he fastened to the stern of his ship. Suitable little pictures may be bought. This piece is nailed flat; the top rail continues over it and similar pieces cover the side joints.

The cow bridge, or midship half-deck, comes next. This is best made of thin three-ply wood, but can be of thin pine about $\frac{3}{32}$ in. thick, with the grain athwart. It lies along the bulwarks until it reaches the after curves, from where it runs straight to the after bulkhead. Its shape will be seen in the deck plan (Blueprint No. 76). It is planked-marked across, butts up to the forward bulkhead, and has an extra support underneath with some posts glued to the bulwarks and four posts under the inner edges. If of pine, it had better have a thin batten glued along the (*Continued on page 131*)

(S) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The True *Santa Maria*

(*Continued from page 130*)

inner edges to prevent splitting when bent to the sheer of the bulwarks.

The wales, or longitudinal strengtheners, should now be glued and nailed on. These also may be of pine, but rattan, reed or cane, such as is used by chair menders (they call it spline) for fastening woven cane seats in place, is better because it bends easily without steaming. Nearly 20 ft. of this will be wanted, ⅛ in. thick and 3/16 in. wide. Their position is shown in Fig. 2. The first one starts at the curl of the stem, comes level with the top edge of the cow bridge at station point III, and continues to the stern at the lower edge of the poop overlay. The others are parallel, except that they are slightly closer at the ends.

IN BETWEEN these, plank marks may be scored with a sharp point. The upright skids are half-lapped (skid and wale being notched) so that they set in almost flush. They are splines of the same size. Note that the midship ones are almost upright, but that the others slant more and more as they work fore and aft. If they are fastened with round-headed nails, such as escutcheon nails, the effect is good. The short pieces at the forward end of the cow-bridge are set in between the skids.

We have now done all the heavy work. If you have finished this before the next issue appears, you can give the lower part two or three coats of flat white paint up to the water line (top edge of D), the deck a coat of light brown stain, and the rest of the hull some darker stain. The final coloring will come later. You can also make a temporary base in which to hold the model upright. Such a base may be seen in the illustration at the top of page 82. The top part revolves on a peg in the lower.

Next month Captain McCann will tell how to complete the hull and make the small fittings.

How I Made a Desk

(*Continued from page 126*)

raw and burnt umber, raw and burnt sienna, Prussian blue, ultramarine blue, cobalt blue, chrome green, American vermilion, or mixtures of these colors. Yellow ochre, lampblack, chrome yellow and white lead are not glazing colors because they are too opaque. To make gray glaze finishes, mix raw umber and ultramarine blue and use over a white ground.

A great number of two-tone effects may be had by using these glaze colors over the same or various light colored grounds. For instance, the same ground coat color was used on the interior of this desk, but the glaze color used was American vermilion instead of raw umber. A totally different effect was gained.

After the glaze-stain coat had dried about forty-eight hours, a coat of clear brushing lacquer was applied. Varnish could have been used, but the lacquer is more transparent and, therefore, did not give a yellow cast to the surface as would have happened if varnish had been used. The brushing lacquer was applied the same as varnish with an ordinary 2½-in. varnish brush.

In an article scheduled for early publication, Mr. Vanderwalker will tell how he made the hand-wrought hinges for the desk from common barn door hardware and finished them with silver leaf. Readers of POPULAR SCIENCE MONTHLY *who happen to be painters and decorators will recognize Mr. Vanderwalker, or "Van" as he is familiarly known, as one of the leading authorities in their own field and the author of "Interior Wall Decoration," "House Painting Methods," "Wood Finishing" and other books. He will contribute regularly hereafter on subjects of interest to amateur painters.*

How many are 421,000 stockholders?

An Advertisement of the American Telephone and Telegraph Company

ON OCTOBER 15th, American Telephone and Telegraph Company checks representing the 152d dividend were mailed to its 421,000 stockholders. That is the largest number of stockholders of any company in the world. The American Telephone and Telegraph Company is owned by a great investment democracy. Its dividend checks are cashed at banks in every state in the Union, by people representing all trades, stations and professions.

No institution is more nationally or publicly owned than the American Telephone and Telegraph Company, which in turn owns more than 91% of the common stock of the operating companies of the Bell national System. The average holding is 26 shares, and no one person owns as much as 1% of the total stock.

The Bell System was developed in the interest of telephone users and is owned by the public that it serves.

A 2c STAMP —will start you on the road to success. See Money Making Opportunities on pages 146 to 174.

$25

This ◇ Reg. Trade Mark guarantees you genuine diamonds.

SEND NO MONEY

Genuine Full Cut Diamonds No Chips

Terms (6 Mos. to Pay)

No. 6132. Solid Gold Men's Initial or Emblem Ring. 2 Genuine Diamonds 4-100 ea. 14-Kt. White Gold Top. Emblem (any lodge) or any initial (Old English) Yellow or White Gold Inlaid in Genuine **Hope Ruby or Black Onyx.** Mention if desired in solid white gold or green gold. same price.

No. 6746. Genuine Double Head Cameo (raised hand carved heads); 1-piece stone. **Heavy Shank,** in White Solid Gold or Green Gold. Genuine Stone—onyx (nicely shaded). Send number of ring, size of finger, initial or emblem desired, and ring will be sent for inspection.

No. 6746.

Ask for free Jewelry Catalog

Buffalo Jewelry Mfg. Co. "The Mail Order House"
Dept. A (or at your Jeweler's)
501 Washington St. Buffalo, N. Y.

Exact size of ring

$24

IF YOU CAN USE AN EXTRA $20.00 BILL

write for this

FREE BOOK

YOU can save $20.00 in no time by using

SMOOTH-ON No. 1

to do your own household repairing—and in addition you will have that proud "I-did-it-myself" feeling.

Here is what one enthusiast did with two 35 cent cans:—A $25 lamp stand loose in base, two big leaks in heating furnace smoke pipe, loose hammer handle, and three loose hooks in tiled bath room wall were all put into good usable condition at an average cost of 10 cts. for each repair—and $20.00 easily saved over what would have been paid to professional fixers or for new parts.

By using Smooth-On to make dozens of the simple repairs necessary in every home, you can save enough to pay your radio upkeep, buy yourself or your wife a camera, a bull pup or some other pleasure giving article that you would otherwise hate to spend the money for.

On the Automobile

Smooth-On No. 1, being unaffected by water, oil, gasoline or heat, is also excellent for automobile repairs. Try it for stopping radiator, tank, pipe line and hose connection leaks from the outside, keeping exhaust line connections tight to prevent the escape of obnoxious burnt gases, repairing cracked water jackets and crank, gear and differential cases, keeping grease cups, lubricator connections, nuts and hub caps from loosening and falling off, tightening loose hinges, robe rails, etc.

The FREE Smooth-On Repair Book

will show you how an astonishing number of home and automobile repairs are as easy for you to make as for somebody else.

Mail the coupon for a free copy and get Smooth-On No. 1 in 7-oz. or 1 or 5-lb. can from any hardware store.

Smooth-On Mfg. Co.
Dept. 58, 574 Communipaw Ave.
JERSEY CITY, N. J.

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO., Dept. 58,
574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name.....

Address.....

12-27.....

Return this coupon for a FREE copy of Booklet

Metal Work for Beginners

(*Continued from page 80*)

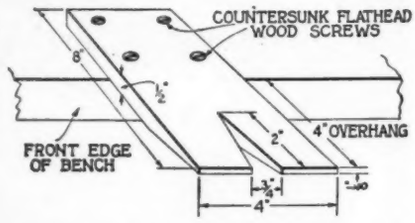


Fig. 6. If it is not convenient to mount bench pin by mortising, screw it on

the side of the treadle has much to do with the ease of operation; it is best to try several points in relation to the distance from the hinge end of the treadle before finally screwing it in place.

When an old balance wheel is used, some sort of a shaft and crank must be rigged up. One way is to obtain a piece of shafting slightly larger than the hole in the wheel and forge or have forged a crank at the end, and then mount the piece in a lathe and turn down the shaft to fit the wheel (A, Fig. 1). Another method is to find or buy a disk crank (B) to fit the wheel shaft and drill a hole for a bolt. Two nuts, one on each side of the disk, hold the bolt, while the head of the bolt holds the connecting rod. Perhaps a regular crank-shaped piece may be obtained and held to the shaft with set screws.

The simplest method probably is to drill a hole on one side of the hub of the wheel (D) and tap it for a bolt. A piece of iron pipe is used for a bushing to keep the connecting rod from striking the wheel.

The crank and roller bearings sold for mounting grindstones sometimes make an excellent mounting for a foot wheel.

It is quite important not to have too great a throw between the center of the shaft and the crank pin. A large throw will result in an exaggerated foot motion. The distance of the throw of the crank shown in Fig. 1 is 1¾ in., which is ample for an 18-in. wheel.

Much work may be done with a ⅛-h.p. polishing motor of the kind that sells at from $20 to $35. Larger work requires a motor of from ¼ to 1 h.p. or more. For very large bowls and trays, you will find that you will need at least a ½-h.p. motor, although much depends on the size of the polishing wheel used and the skill of the operator.

If you already have a small electric motor about the shop, say a ⅛-h.p., you may rig up an excellent little polishing head by mounting the motor and the head on a board or on the bench and connecting them with a sewing machine belt.

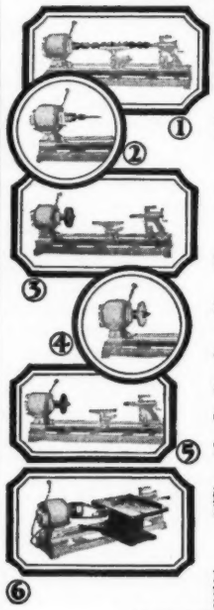
When a foot- or power-driven lathe fitted with a drill chuck is available, you may use this as a polishing head, or as a grinder, for that matter. The head may be sawed off a large wood screw and the shank of the screw held in the drill chuck on the lathe; then, using a flat file or a lathe tool, turn off a part of the screw threads in a taper so that just a part of the original thread shows at the point of the screw and the full thread is left at the shank (see Fig. 4). On this you may screw polishing wheels or buffs, and the taper thread will hold them in place as they revolve.

Also, it is quite possible to get attachments which fit on the end of small motor shafts, one for holding emery wheels and another with a taper thread for polishing wheels. These convert a plain motor into a polishing motor at small expense.

If you have gas piped to your shop, you will find it most convenient for a soldering blow torch driven by a foot bellows, for Bunsen burners, and for a small gas plate. The gas should be piped, if possible, along the soldering bench, with (*Continued on page 133*)

Speed Way Shop (IS)

Completely Motorizes Your Work Bench



Let your home workshop be a practical workshop—the kind used by carpenters, small manufacturers, machine shops, craftsmen—costs no more!

The Super SpeedWay Shop model "S-S," shown contains:

Seven Heavy Motor Driven Tools

1—Motor Driven Lathe on heavy cast-iron base; takes up to 10 in. diameter and 18 in. length.
2—Speedway Bench Drill, ¼ in. in steel or ½ in. in wood.
3—Bench Saw with 6-inch blade; rips, cross-cuts, mitres, groove.
4—Pattern Makers' Jig Saw with 10 in. throat.
5—Motor-driven Grinder, 5 in. emery wheel.
6—6-inch Metal Scratch Brush.
7—6-in. Buffer and Polishing Wheel.

All necessary parts, supplied, including two chisels, jig saw blades, etc.

Have Fun or Make Money

Dozens of men are making money with a Speedway Shop.

Only $10.00 Down

We ship on a down payment of $10 which is refunded if you do not keep the Shop. Balance is paid in easy monthly payments while you use it.

24 Free Blue Prints

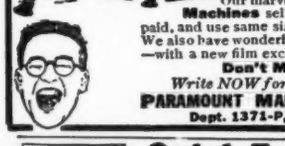
With each Shop we furnish free 24 working blue prints.

Send Coupon Today

Write to the world's only manufacturer of a complete line of Portable Electric Saws, Hammers, Drills and Grinders, for our 10-day Free Trial offer.
No. 1 Shows set up for wood turning. No. 2 Ready for Drilling. No. 3 For all grinding jobs. No. 4 Buffing Wheel. No. 5 Metal Scratch Brush. No. 6 Bench Saw.

ELECTRO MAGNETIC TOOL CO., Dept. 5-D,
1830 S. 52nd Avenue, Cicero, Ill.
(Adjoining Chicago)
Sales and Service in all principal Cities.
Please send Catalog and 10-day Free Trial Offer on the new Super SpeedWay Shop.
Name.....
Address.....

Sport Bodies for Fords
at FACTORY PRICES!

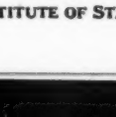


This Model In Grey Prime $39.50
Write for Booklet A-10 Showing Other Models.

SPORT FACTORIES, Aurora, Illinois

MOVIES In Your Home

Our marvelous, practical Movie Machines sell as low as $3.75 postpaid, and use same size film as big theatres. We also have wonderful films at lowest prices—with a new film exchange service.
Don't Miss This!
Write NOW for Free Catalogues.
PARAMOUNT MANUFACTURING CO.
Dept. 1371-P, Boston, Mass.



Quick Easy Profits

Practically no investment. Small space required. Steady demand and BIG PROFITS refinishing Autos, furniture—painting houses and barns with HB quick spray method. Spray equipment for Duco, Paint or Lacquer recommended by car manufacturers. One man does the work of five with brushes. Pays for itself on easy monthly payments. 30 DAYS TRIAL. Write today for details.

Hobart Brothers Co. Box P1271 Troy, Ohio

(IS) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Metal Work for Beginners

(*Continued from page 132*)

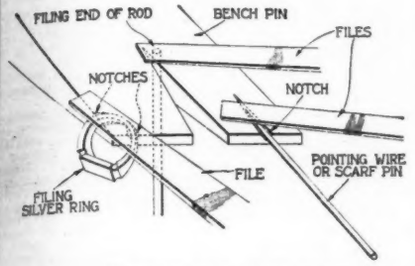


Fig. 7. Three types of jobs where the bench pin is useful for holding work

three outlets or cocks for hose connections. At your smaller bench for light work, if you have one, two connections will prove useful, one for a small gas blowpipe and the other for a small Bunsen burner.

If you live in the country, as I do, you will find that a plumber's gasoline blowtorch is an excellent source of heat for large work properly set up in the soldering box. I have two of these torches and frequently use both of them at once, one in each hand.

For my small soldering, I use an alcohol blowtorch, and for this the current of air is furnished by blowing through a tube. I use the lamp from an old chafing dish as a Bunsen burner, also a jeweler's soldering lamp with a ball-shaped glass fount which may be turned about in its socket to make the flame convenient for blowpipe or other work.

When fitting up a shop for metal working, you should provide some place for scrubbing your work. Almost all work that is annealed or hard soldered is scrubbed with a brush wet with water and charged with powdered pumice stone to remove traces of the pickle and any dirt. A piece of flat board may be laid on the bench and the work scrubbed on it, or a wooden box may be placed near the sink, if you have running water in your shop. The reason a scrubbing board, box or bench is needed is because you must have some place where the spatter from the scrubbing brush will not fly on your tools or work, for wet pumice very quickly rusts steel and stains copper.

The construction of the simple but very much used bench-pin is shown in Fig. 5. This is made of hard wood. It may fit in a mortise in the front of the bench, as shown in the first article in this series (page 119, November issue), or it may be a single piece of fairly thin hardwood screwed to the bench as shown in Fig. 6. The methods of handling work illustrated in Figs. 7 and 8 may very well be adopted by the model maker as well as those interested in jewelry or other light metal work.

This is the second of a series of articles by Mr. Thatcher on decorative metal work for amateur craftsmen. The third, which gives plans for a completely equipped shop, is scheduled for early publication.

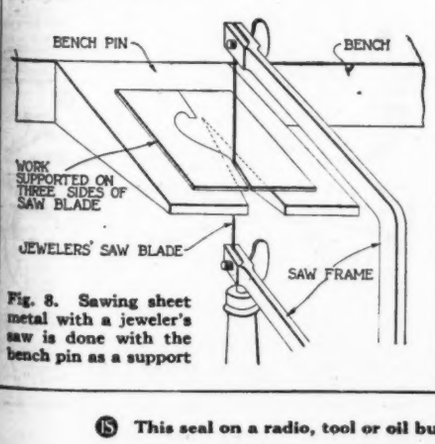
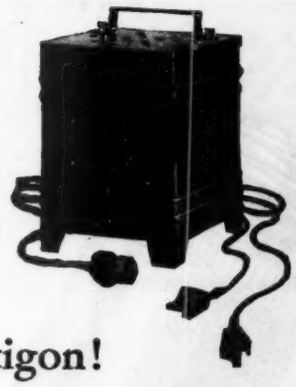


Fig. 8. Sawing sheet metal with a jeweler's saw is done with a bench pin as a support

Want *trickle charging?* Want *full rate charging too?* then you want Rectigon!



YOU need only one charger—the Westinghouse Rectigon.

Rectigon gives you two charging rates — a "trickle" and a "high". With it you can get everything that you want from a trickle charger. But, when your set has been in almost continuous operation for a number of hours and a trickle charger can't bring the battery back — then's when you'll need Rectigon most. For Rectigon's high charging rate will give the battery its full strength quickly and surely. Another change of the Rectigon leads and you recharge your wet "B". Also charges your automobile battery. *All with one charger—the Rectigon.*

3 Ampere Rectigon ~~$18.00~~ now $14.00

5 Ampere Rectigon ~~$28.00~~ now $24.00

Westinghouse makes Rectigon — and Westinghouse knows radio. You remember when the first program came from KDKA—perhaps you're listening to Westinghouse radio every night now. Rectigon is simple and safe. It uses no acids or chemicals—has no moving parts to break or wear out. No harm done if you tune in while charging—none if the power goes off while Rectigon is in the circuit. For the cost of a few outside chargings, you can put Rectigon in your cabinet and forget the annoyance of weak or run-down batteries.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., E. PITTSBURGH, PA.
Offices in all Principal Cities ✦ *Representatives Everywhere*
Tune in with KDKA—KYW—WBZ—WBZA

Westinghouse Rectigon Battery Charger

Rectox—for trickle charging only—will transform your wet "A" battery into a light-socket power unit. Charging starts every time you turn off the set. Rectox is trouble free—uses no acids or chemicals, has no moving parts. Adjustable to ½ or ¾-ampere charging rates. At your dealer's.

Besides Rectigon and Rectox for better battery charging, Westinghouse also makes Micarta panels and tubing for better insulation, and radio testing instruments for better reception.

TWO New Boice-Crane Machines

Boice-Crane has perfected two more time and labor savers—a Universal Handisaw and a wood and metal working lathe. It is amazing the work these machines will do.

Universal Saw as shown has table 15" x 17". Elevates for grooving; tilts 45° for beveling. Swings 9" saw; cuts 2 1-2" stock. Insert takes Dado Head 6"x1", Cope Heads and 8" Sand Disc. Also has insert providing opening for 2" Jointer Head. Jointer attachment quickly fits on right of table. Other new, low cost attachments will plane boards to Thickness, Mortise, Shape, Bore, Tenon, Drum Sand, Grind, Disc Sand, Rout, Polish and Make Mouldings.

Write for further information on these two new machines. Send 10c for 64-page booklet on complete lines of Boice-Crane Band Saws, Circular Saws, Jointers, Lathes, Drills, Mortises and Jig Saws.

W. B. & J. E. Boice Dept. P. S. 12-C Toledo, Ohio

Wood and Metal Lathe

A practical, substantial, low-price lathe. Will do as much work as any other lathe of similar cost. 3 speeds for both wood and metal turning. 7" swing. 17" C. to C. Longer bed may be had up to 48" C. to C.

Jig saw Attachment $8.00. Cuts 1" stock. Uses blades ⅛" to ¾" wide. Circular Saw Attachment $11.50. Cuts 1" stock. Table 7" x 9".

Price $13.50 for wood turning. With compound Slide Rest as illustrated, add $10.50.

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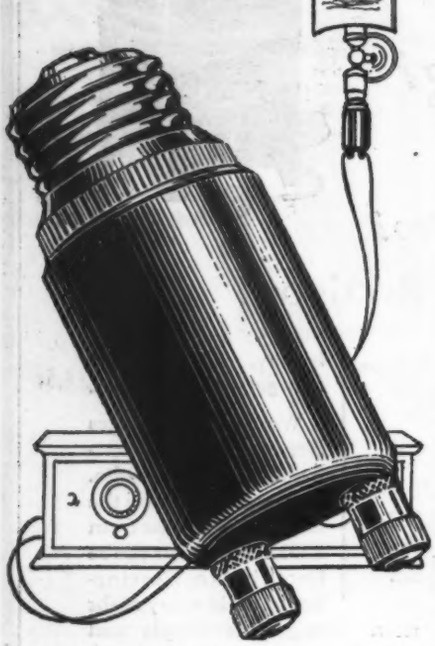
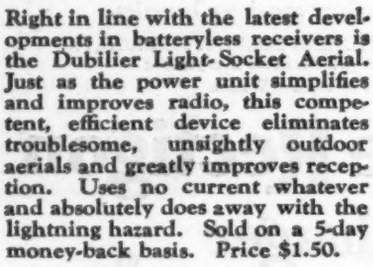


The Era of Light-Socket Operation

Right in line with the latest developments in batteryless receivers is the Dubilier Light-Socket Aerial. Just as the power unit simplifies and improves radio, this competent, efficient device eliminates troublesome, unsightly outdoor aerials and greatly improves reception. Uses no current whatever and absolutely does away with the lightning hazard. Sold on a 5-day money-back basis. Price $1.50.



Building a Power Unit?

Then you'll want condenser blocks you can bank on for long life and safety under heavy loads. Dubilier Blocks are official with such well-known manufacturers as Raytheon, Acme, Thordarson, General Radio, etc., and with experimenters who have always turned to Dubilier as a matter of course for dependable condensers.

All good dealers have them.

DUBILIER CONDENSER CORP.
4377 Bronx Blvd. New York

Dubilier
CONDENSERS

Lighting Your Tree

(*Continued from page 76*)

cord belt. A rheostat can be mounted near the motor for regulating the speed.

At the rear of the top of the disk, arrange a magic lantern lens close to the colored windows so the rays will be thrown directly through them as they pass by. In case a lantern cannot be procured, an automobile headlight can be substituted after cutting down the lens opening with a suitable mask to match the opening size in the disk.

This outfit can be built to use either 110-volt apparatus or to operate from a storage battery. Mount it on a suitable shelf at the other side of the room and then, after lighting the projector, start the motor. The slowly revolving disk will continuously and automatically change the color of the light thrown upon the tree. With the proper arrangement of colors on the disk and an even speed, the effect can be made magically beautiful in a darkened room.

Have you a few of those ever-present hollow ornaments that you hesitate to use because the tops are broken off? If so, here is a way you can give them a new lease on life and heighten the decorative effect of the tree. Cut the neck of the ornament off with a sharp knife so that the opening is wide enough to admit a Christmas tree bulb as in Fig. 3. Then wrap adhesive tape about the socket and the top of the ornament and cover it with a narrow strip of decorative paper. Such translucent ornaments, when illuminated from the inside, are highly pleasing.

PERHAPS you cannot obtain a sufficient variety of colored lights where you live. Then here are methods of dyeing plain glass bulbs. The process is simple and inexpensive.

Soak a small quantity of gelatin in cold water until well softened. Then boil and strain through very fine cheesecloth. While this preparation is still hot, add sufficient aniline dye to give the required color. The dye should be made into thin paste with water before adding to the gelatin. When the gelatin is thoroughly impregnated with color, dip the bulbs in it and stand them vertically to dry.

Another way is to dissolve several old photo films, from which the gelatin has been removed, in a solution of equal parts of ether and alcohol. Add the dye and dip the bulbs as before. This coating is waterproof.

These ideas can, of course, be easily modified or improved by anyone with inventive ingenuity, and it is hoped they may lead to many pleasant surprises this year in the way of Christmas tree illumination.

Decorating Gifts

(*Continued from page 126*)

Then apply a coat of shellac over the cheesecloth, brushing it out evenly and thoroughly into the meshes. As the shellac dries, it will cement the cheesecloth to the print. The texture gives a surprising softness and richness to the print and makes a truly artistic picture, which can be framed, passe-partouted or mounted on a plaque and polychromed, as desired. It may be used without glass, as the shellacked surface will permit wiping off with a damp cloth whenever necessary.

The cheapest grade of cheesecloth, very sleazy and with wide meshes, should be used. The better grades, which are closely woven, hide the picture too much.

The cheesecloth should be shaken just before using to remove loose pieces of lint. In some cases the shellac "bleeds" the colors in the print and causes them to run a little, but this is seldom objectionable. The colors generally seem to blend together so that the effect under the meshing is quite delightful. If the picture does not show through plainly enough, apply a second coat of shellac.

Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for Oct. 1, 1927, State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Popular Science Publishing Co., Inc., 250 Fourth Avenue, New York, N. Y., Editor, Sumner N. Blossom, 250 Fourth Avenue, New York, N. Y. Managing Editor, Raymond J. Brown, 250 Fourth Avenue, New York, N. Y., Business Manager, O. B. Capen, 250 Fourth Avenue, New York, N. Y. 2. That the owners are: Popular Science Publishing Company, Inc., 250 Fourth Avenue, New York, N. Y., Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 31 William Street, New York, N. Y.; Oliver B. Capen, 250 Fourth Avenue, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Ada B. Wilson, 683 Springfield Ave., Summit, N. J.; L. B. Tunison, 6 N. Michigan Ave., Chicago, Ill.; A. L. Cole, 250 Fourth Avenue, New York, N. Y.; Godfrey Hammond, 250 Fourth Avenue, New York, N. Y.; Sumner N. Blossom, 250 Fourth Ave., New York, N. Y.; John Nichols, 250 Fourth Ave., New York, N. Y. 3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. Capen, *Business Manager.*

Sworn to and subscribed before me this 22nd day of September, 1927.
Bertha Strauss, Notary Public, New York County. New York County Clerk's No. 547, New York County Reg. No. 9195.
(Seal) My Commission expires March 30, 1929.

YOU CAN BUILD
This 3 ft. Cone Loud Speaker in less than an Hour.

The famous "Ensco" 3-foot Cone has been enthusiastically endorsed by the leading engineers of America. Guaranteed equal to any manufactured speaker. Can be used on any set operating loud speaker. ***Write for Booklet M, giving complete information, remarkably low prices, etc.***

ENGINEERS' SERVICE CO.
25 Church St. New York City

BUILD THE REAL
SANTA MARIA

Our special construction set consisting of all necessary material such as semi-finished hull, all deck materials, rigging line, sail cloth, finished metal guns with mountings and countless other requirements will save you a great deal of time and assure an exact model. Our new catalog describing this set and showing reproductions of actual photos of original models with prices of hulls, blocks, dead eyes, guns, etc., for all Popular Science models sent postpaid upon receipt of 10 cents.

SHIP MODEL SUPPLY CO.
Dept. S Mineola, N. Y.

ZIP-ZIP SHOOTER
CAMPERS AND TOURISTS:

Here is the very thing for you: campers tell us that this is the greatest weapon to be had where fire arms are prohibited. Zip-Zip Shooter is noiseless, powerful and effective and is used by a great number of tourists and campers. Thousands of boys are made happy with this wonderful Zip-Zip Shooter. If your dealer happens not to have them order from us. Zip-Zip Shooter 35c or three for $1.00. Send stamps, coin or money order.

Automatic Rubber Co.,
Dept. B.B., Columbia, S.C.

RADIO AGENTS
Make Big Money

EASY to sell American Radios and Supplies. Nationally advertised, high quality merchandise at wholesale. Big profit on every sale. No capital to invest. No stock to carry. Order direct from my huge warehouse as you sell.

Get My Liberal Offer and also Big New 132-page Catalog and Guide—"How to Sell Radios"—Free. Full of Bargains—all latest in Radio. Write today.

AMERICAN AUTO & RADIO MFG. CO.
HARRY SCHWARTZBERG, PRES.
Dept. 286 American Radio Bldg., Kansas City, Mo.

Ball Bearings Used as Wheels for Scooter

IN LESS than an hour's time the scooter illustrated was made from a few scraps of crating and four discarded ball bearings. Such bearings are replaced in automobile shops when they show wear beyond a certain "tolerance," but for many uses are still quite serviceable. On this scooter, for example, they are far better than wheels from roller skates.

A scooter for a small child made from crating strips and four discarded ball bearings

The front and rear axles were made from short pieces of hardwood larger in diameter than the hole in the inside of the bearings. The ends were whittled to make a slight drive fit into the bearings, and a hole was drilled for a cotter for each bearing. The handlebar support is inclined backward at a slight angle; two short pieces on each side serve to brace it firmly.

The scooter shown has been in service for more than seven months, needing but a drop of oil occasionally in the bearings. The four points of support make it safe for even a small child.—SHERWOOD J. GEE.

A Screen for Home Movies

IN PLACE of a sheet or tablecloth, which so often is used as a makeshift screen for a small motion picture projector, it is possible for anyone to make an excellent silver screen. Any material that is plain white, closely woven and of a fairly heavy texture will do; oilcloth of the kitchen table variety gives excellent results. A good working size is 4 by 4 ft. The other materials needed are clear varnish and aluminum powder.

Apply the varnish very evenly with a brush (in the case of oilcloth, to the coated side). Allow it to set a little, but do not let it get too dry. Then apply the aluminum powder by shaking it through a piece of cheesecloth on to the sticky varnish. After it has dried, the excess powder can be shaken off.

Attach two sticks to the opposite ends. The bottom stick should be round; an old broom handle, sandpapered and painted, will do nicely.

At a little extra expense the top can be attached to a spring shade roller and the hangers mounted on a board. —ALBERT L. SNEDAKER.

Make Estwing **"Unbreakable"** Tools Your **Ideal Gifts**

because they are the First and Only Guaranteed by Free Replacement that the light tempered handle and comfortable leather grip will never break or loosen, no matter how or how long used. Their edge, face and claw are unsurpassed. They will satisfy you in EVERY way.

These Fine Looking and most useful tools will please their proud owners

A LIFETIME

Wished for since the stone age by every man and boy.

IF *they cost* **$6** *they would still be a bargain.*

Show this to your dealer, he will be pleased to serve you. Or send money with order, inclose 15c extra for each tool ordered which pays postage; or pay mail man.

☐	Curved Claw Hammer, 12 oz. Head	$2.00
☐	" " " 16 " "	2.00
☐	" " " 20 " "	2.25
☐	Straight " " 12 " "	2.00
☐	" " " 16 " "	2.00
☐	" " " 20 " "	2.25
☐	Half Hatchet No. 2, Smooth Face	2.25
☐	" " " Scored "	2.25
☐	Util-ax 28 oz. with Leather Sheath	2.25
☐	Scout Ax, 24 oz. " " "	2.00
☐	Ball Pein Hammer, 16 oz. Head	1.75

In **FREE** Special Four Color **Christmas Boxes**

Estwing Mfg. Co. (IS)
ROCKFORD, ILL.

Make More Money

Read the Money Making Opportunities on pages 146 to 174 of this Issue.

MEN'S STRAP WATCH DIRECT FROM SWITZERLAND **$3.99**

Radium Dial Jeweled Movement — Silveroid Cushion Shaped Case

This fully guaranteed watch cannot be manufactured in America for less than $12. Genuine leather strap. Accurate—durable—handsome. SEND NO MONEY. Pay on delivery $3.99 plus postage. "FEDCO" U. S. Swiss Agents, 561 Broadway, New York City. Dept. W-18

$10.00 DOWN Brings this Lathe to You!

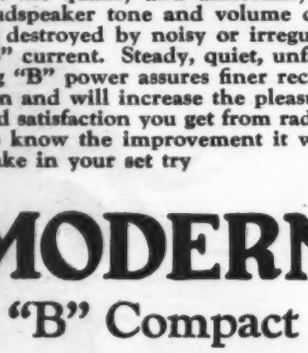
Lathes $6.00 to $75.00. Largest line of small lathes in America. Send four cents for 24 page catalog of lathes, drill presses, bench saws, jig saws, band saws, etc.
SYPHER MFG. CO., DEPT. 6. TOLEDO, OHIO

(IS) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

More Satisfaction *from* Your Radio

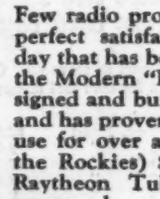
The design and construction of a radio set may be perfection itself, but the quality and uniformity of loudspeaker tone and volume can be destroyed by noisy or irregular "B" current. Steady, quiet, unfailing "B" power assures finer reception and will increase the pleasure and satisfaction you get from radio. To know the improvement it will make in your set try

MODERN
"B" Compact



Few radio products have given the perfect satisfaction from the first day that has been experienced with the Modern "B" Compact. It is designed and built by radio engineers and has proven dependable in daily use for over a year. Price (east of the Rockies) $26.50 not including Raytheon Tube for which it is approved.

The Modern Electric Mfg. Co.
Toledo, Ohio



Send for this booklet, "How to Properly Operate your Set with a 'B' Power Unit."

Modern Electric Mfg. Co., Toledo, Ohio PS-12
Please send booklet on "How to Operate My Set with a 'B' Power Unit." I enclose 2¢ stamp.

Name.....
Address.....
City.....

How to Rig Up a Simple Telegraph Line

IF YOU wish to connect up a telegraph or buzzer line with the fellow next door or within two or three hundred feet of your own home, the accompanying diagram will show you how to do it in the simplest possible way. Only one wire is run between the houses, no switches are used, yet a pressure on either key operates both telegraph instruments or buzzers. The arrangement is of the open circuit type, so that no current flows except when the keys are pressed.

The parts consist of A and B, which can be either telegraph keys or any type of push button; C and D, each a battery of from one to three or more ordinary No. 6 dry cells, the number depending on the length of the line; E and F, ordinary bell buzzers or telegraph sounders. Bell wire

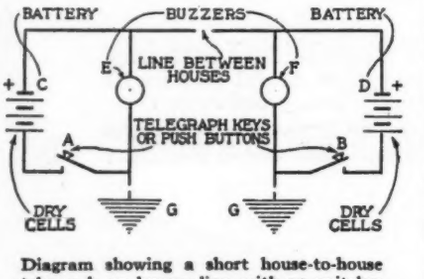


Diagram showing a short house-to-house telegraph or buzzer line, with no switches

can be used for all connections, although if you find it necessary to have the wire between the houses strung over 50 feet between supports, it would be desirable to use radio antenna wire at these points in the circuit. At each house a wire is run, as indicated by G, to a ground connection, preferably a water pipe.

When key A is pressed, current flows through buzzer E and also through F by way of the wire between the houses and the water pipe return. When key B is depressed, both instruments are operated by current from battery D. If a message is being sent from one end of the line and the operator at the other end desires to cut in, he presses his key and the buzzers sound continuously, or the arms of the telegraph instruments remain in the down position, so that the sender knows that the operator at the other end wishes to break in.

Make sure that the batteries are connected at each end with the positive toward the line between the houses, as otherwise there will be a direct short circuit if both keys are depressed at once.—A. P. L.

Cutting Odd Shapes in Glass

IT IS occasionally necessary to cut window glass into an irregular shape. Provided the edges do not have to be smooth and very accurate, the cutting can be done in a tub of water with tin snips or large scissors. Keep work and hands entirely submerged. The same result can be accomplished without water, although less easily, by breaking off minute pieces with pliers. For cutting circular pieces, it pays to buy a regular cutter made for this purpose.—J. C. H.

A Weatherproof Aerial that can't corrode

It is not necessary to take down your aerial each year to remove corrosion and soot that have accumulated on its surface, if you install a Beldenamel Aerial.

Each strand of a Beldenamel Aerial is protected by a heavy coat of baked enamel which resists corrosion under the worst atmospheric conditions. A Beldenamel Aerial stays bright under this protective coating and maintains maximum range and volume for your set.

A good aerial is just as important as good tubes. Get the best results from your radio receiver by asking your dealer for a Beldenamel Aerial today.

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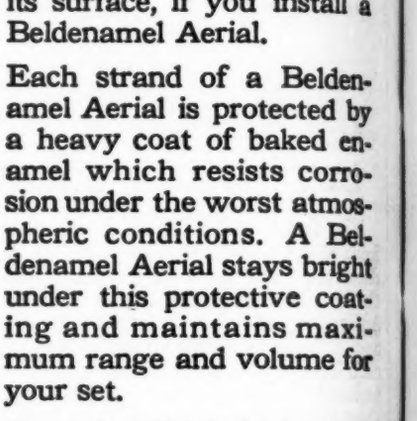

Specify Belden
AERIAL WIRE

"Your Car Need Never Freeze"

(*Continued from page 69*)

away. "When a motor sticks like that from overheating," he explained, "it's because the piston has kept expanding until it won't slide up and down in the cylinder any more. Generally the cylinder walls get burned a bit but if the motor is just running idle as yours was, as soon as the pistons cool off they'll slide again, although sometimes they practically weld themselves to the cylinder walls and you're in for a fat repair bill.

"The compression seems all right," Gus continued, "so it's a safe bet that none of the rings broke, and if the burned streaks don't start it to pumping oil and fouling the plugs no damage has been done."

"That's something to be thankful for," agreed Madden, "but all the same I hate to go back to alcohol. It's such a blamed nuisance. Isn't there something else I can use to keep the radiator from freezing? You never know how much alcohol you've got. Every time the motor gets good and hot going up a hill a lot of alcohol boils away and the same thing happens even on level going whenever there's a warm day in winter."

"THAT'S true enough," Gus agreed. "Of course alcohol has its disadvantages. The low boiling point is one of them. On the other hand it is much better than the calcium chloride preparations because alcohol doesn't cause any corrosion—but why don't you use glycerine? I know it costs a lot more to fill your radiator with the proper mixture of glycerine and water when you start using it, but it really is cheaper in the end, because you can use the same glycerine year after year if you're careful. The glycerine in my radiator is three years old."

"Three years old!" exclaimed Madden in great surprise. "But doesn't it evaporate or get sour or something? If the motor gets hot doesn't it boil away?"

"You couldn't lose a drop by evaporation or boiling if you wanted to," Gus replied. "The only thing you've got to be mighty careful about is leaks in the cooling system. It wouldn't pay to use glycerine if the hose connections dribbled water or the pump packing gland leaked a drop now and then. You've got to have them absolutely tight. Glycerine is like kerosene in that it will seep through a crack that water can't get through.

"Glycerine doesn't evaporate at all in the ordinary sense, and it boils way above 212 degrees, so if the motor overheats, the water boils away and leaves the glycerine right in the radiator.

"THERE'S one point you want to watch out for. You may lose some glycerine if the motor boils so hard that the steam bubbles raise the level of the solution in the radiator high enough to force a lot of it out the overflow pipe. You can overcome that by slipping a piece of rubber hose on the end of the overflow pipe and tieing the other end into an old tin can fastened beside the motor near the radiator. Then if steam blows off any of the solution, it will be caught in the can and you can dump it back in the radiator."

"Sounds good," agreed Madden. "Where do you get the glycerine?"

"You can buy it at the drug store," Gus told him, "but it will cost quite a bit, because the glycerine they sell in drug stores is a lot purer than you need. Several brands of a lower priced glycerine refined especially for automobiles are for sale now. We carry a good supply. Want to try it?"

"I know the answer to that one," laughed Madden. "It's yes! And even if the car does smell like an old lamp from that confounded kerosene I'll know I'm not going to get another shower bath from it!"

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Here, for $65.00, is all you need in a Radio Receiver! It's a six tube model, with the marvelous Day-Fan tone—extraordinary in so compact a set. It has Range, Volume, Selectivity. It is sweeping the country. Remember that Day-Fan is the radio used by great broadcasting stations to "listen in". What greater proof do you want that

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Protect Your Tools From Theft. Write with electricity any name or design on the hardest and finest tools and instruments, or any metal, like writing on paper with pen or pencil. Complete Outfit $3.50 Prepaid Anywhere. Interesting illustrated circular free. Write today. Agents wanted.
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See Miles Away! Distant people and objects seem close. Wonder telescope opens 3 1-2 ft. long, 5 sections, brass bound, powerful lenses. C. Palmer wrote: "See numbers on cars mile away; see mountains on moon." All pleased
Free Carrying case Strap and Solar Eye Piece to view the Sun.
SEND NO MONEY! On arrival pay Postman $1.85 plus postage. (2 for $3.50) Money back guarantee.
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Breed squabs and make money. Sold by millions at higher prices than chickens. Write at once for two free books telling how to do it. One is 40 pages printed in colors, other 32 pages. Ask for Books 3 and 4. You will be surprised. Plymouth Rock Squab Company, 615 H Street, Melrose Highlands, Massachusetts.

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Build Your Own POWER AMPLIFIER!

Transform your RECEIVER into a real MUSICAL INSTRUMENT

WITH a screw driver, a pair of pliers, and a soldering iron you can build a Thordarson Power Amplifier and B-supply in your own home that will equal the finest commercial amplifier on the market. Complete constructional booklet and simple diagram accompany every transformer.

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The Thordarson R-210 Power Compact is scientifically designed to give maximum electrical efficiency and to make home assembly of power amplifiers as simple as possible. The R-210 power compact is the foundation unit and contains the following apparatus: (1) A power supply transformer designed for UX-216-B rectifier; (2) Two filter chokes of 30 henries inductance and 65 M. A. current carrying capacity; (3) A 7½ volt supply center tapped for the filament of one UX-210 power tube. Wiring of the complete amplifier is simple—20 leads complete the assembly.

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To further simplify home construction of the R-210 type amplifier, you can now buy this new crackled finished metal baseboard. All spring sockets and binding posts are mounted and included in the list price. All mounting holes are drilled. All holes for sub-panel wiring are carefully insulated. Location of all sub-panel wiring is marked under baseboard.

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Marconi, Father of Radio

(*Continued from page 22*)

December twelfth, Marconi heard the signals faintly. At ten minutes after one came a succession of S's of unmistakable clearness. Once again Marconi thrilled to hear the clicks that day, and again the following noon.

Two days later the world was told Marconi had spanned the ocean. And, as Marconi fully expected, few believed it!

Modern engineers have called it a miracle that Marconi's crude apparatus was able to detect at all the feeble S's from the wheezy Poldhu transmitter—even present-day stations, they say, might have failed to catch them. Is it any wonder, then, that the startling announcement "OCEAN SPANNED BY WIRELESS TELEGRAPH" was met with skepticism in 1901?

To reporters, Thomas A. Edison, electrical wizard, said frankly, "I don't believe it." Dr. Lee De Forest, inventor of another system of wireless telegraph, doubted it.

IN BRITAIN, none dared deny the signals had been sent, but every one doubted their reception. Then two dispatches reached the press. The first:

"ST. JOHN'S, N. F., SATURDAY—CONFIRM THAT SIGNALS WERE RECEIVED HERE THURSDAY AND FRIDAY DIRECT FROM CORNWALL RECEIVING WIRE SUSPENDED BY A KITE. MARCONI"

And the second:

"SINCE MARCONI HAS STATED OVER HIS OWN SIGNATURE THAT HE HAS RECEIVED THE SIGNALS FROM ENGLAND I BELIEVE HIM AND I THINK THAT HE WILL CARRY IT TO A COMMERCIAL SUCCESS. IT IS A GREAT ACHIEVEMENT, AND HE IS A GREAT EXPERIMENTER. EDISON"

Marconi went to England, and returning, received on shipboard messages from Poldhu, 1,551 miles away. He set up a new station at Glace Bay, Nova Scotia, and exchanged messages with Poldhu.

Where Marconi led other inventors were quick to follow—Fleming with his "valves" and De Forest with his vacuum tubes; Alexander Graham Bell with his wireless telephone; Armstrong and his successors with their oscillating circuits. By 1921, only twenty years after Marconi's first trans-Atlantic test, broadcasting was a fact in America. A year later England, France and Germany had regular broadcast programs.

COMMERCIAL radio—for "radio" it had now become—was making tremendous strides meanwhile. In 1916, Marconi started investigating short wave radio and low-power, high-speed "beam transmission." As early as May, 1924, Marconi telephoned from Poldhu to Sydney, Australia, by beam radio, his voice being clearly received—a little-known event far preceding last year's trans-Atlantic 'phone success.

Now the new Canada-England and England-India beam radio links have shown their unlimited possibilities. An experimental line is to link New York and England. The new beam system has already handled 1,000 words a minute in laboratory tests, the inventor says.

The world is getting smaller through radio. An American motor car company recently dispatched a wireless photograph of its latest model to far corners of the earth. A motion picture producer in London has just bought the $225,000 movie rights to a New York stage success after a conference by trans-Atlantic phone; his actual signature was flashed across the sea by radio. Latest aids to international communication are the new Canada-London 'phone and direct radio service from New York to Belgium.

The Celestial Stradivarius
The Advanced Hi-Q* Six
BOTH CUSTOM-BUILT!

The Hi-Q Six—the newest advance in radio—four completely isolated tuned stages—Automatic Variable Coupling—symphonic amplification. This non-oscillating, super-sensitive receiver assures maximum, uniform amplification on all wave lengths and establishes a totally new standard of tonal quality.

Just as Antonio Stradivari gave the priceless CUSTOM-BUILT violin to musicians of his day, so does Hammarlund-Roberts offer music lovers of our day the CUSTOM-BUILT Radio—

the advanced "Hi-Q Six"—designed by ten of America's leading manufacturers—made with America's finest parts—incorporating every modern constructional feature—and built under your own eyes from plans so complete, so exacting and so clear-cut that the only outcome can be absolute radio perfection. The Hi-Q Six also offers equally unprecedented economy, for thus you save at least $100.00 over the cost of fine factory-assembled sets. Complete parts including Foundation Unit chassis, panels and all wire and special hardware cost only $95.80.

The Hi-Q Instruction Book tells the complete story with text, charts, diagrams and photos. Anyone can follow it and build this wonderful instrument. Get a copy from your dealer or write us direct. Price is 25 cents.

Associate Manufacturers

Carter Radio Co.
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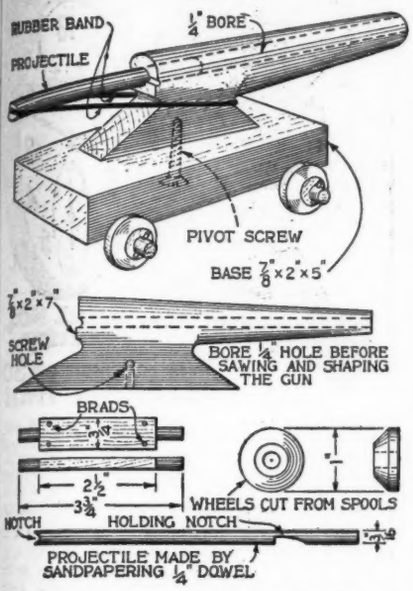
SIMPLE as it is to construct, the toy cannon illustrated is one that can be swung around, aimed and shot with surprising accuracy. All that is necessary is a piece of wood ⅞ by 2 by 12 in., two thread spools, a thin piece of packing case, a few brads, a 1¼-in. wood screw,



The wooden gun ready to shoot, details of the parts, and one of the long projectiles

a ¼-in. dowel for the 6½-in. long projectiles, and a rubber band.

Targets can be made or the small celluloid animals for sale at nearly all ten-cent stores may be used. If you are skillful at sketching, soldiers, houses, trees and animals may be drawn on cardboard and cut out; or pictures from magazines may be suitably mounted.

The "range" is controlled by the addition of more rubber bands or the use of one of greater strength.

A coat of paint or brushing lacquer adds materially to the gun's appearance, or, better yet, a good job of "camouflaging."—WEBSTER S. ANDERSON.

Neat Shelf for Telephone

Phone shelf partly hidden by furniture

A PHONOGRAPH cabinet in the living room was originally the inappropriate although convenient resting place for our telephone. To have placed the receiver in one of the elaborate telephone dolls or containers sold for that purpose would have entailed the trouble of lifting off the doll or opening a door, so we constructed a shelf and screwed it to the wall beside the cabinet, where it is relatively inconspicuous. The shelf, which has retaining side pieces, like inverted brackets, is finished to match the woodwork of the room.—J. F. H.

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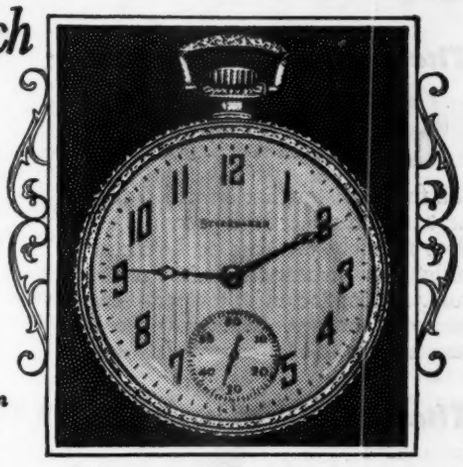

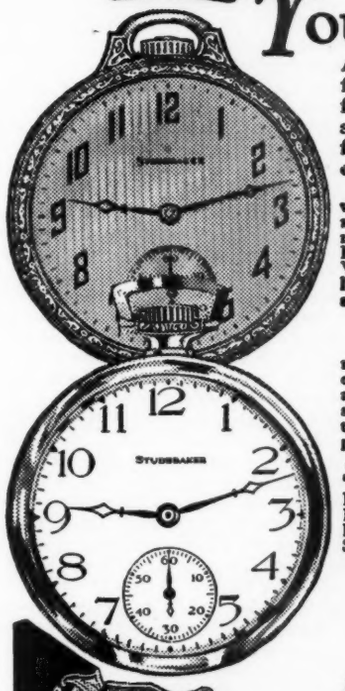

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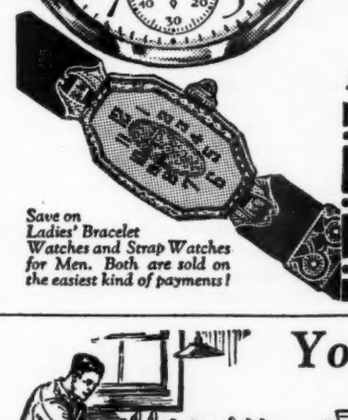

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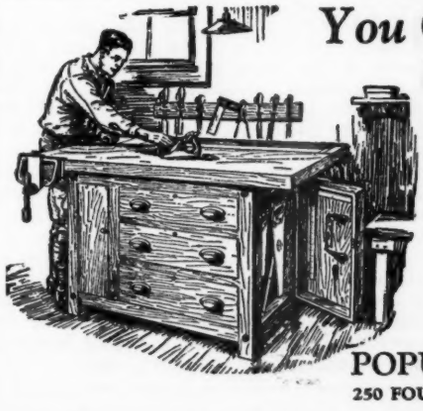

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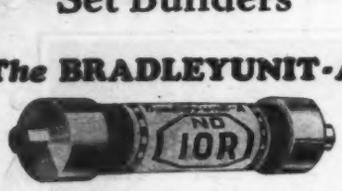

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Electric Controlling Apparatus

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Sir Arthur Keith Says Darwin Was Right

(*Continued from page 80*)

article, you will observe in the latter a striking advance along the road of intelligence. Here, you will agree, is a fine specimen of manhood—a face that is striking if not handsome, with high forehead, strong jaw and chin. The low ridged brow and other brute features of his predecessors have given place to the marks of intelligence and creative power. That he actually was such a man is evidenced by the flint implements he left behind him and by the skillful paintings and sculpture he left on the walls of his caves.

Such is the chronological line of fossil men who bear witness for evolution. Yet, we are warned, while the evidence they present is generally accepted by science, they by no means represent a direct line of ancestry linking men and apes.

MOREOVER, in the chronological succession there remain enormous gaps to be filled in before the evidence of man's anthropoid ancestry is completed. And the emptiest gap lies between the highest kind of anthropoid and the lowest type of man yet found—the Java Ape Man.

It may be that searchers among the rocks will eventually find this forefather in a still more remote past than that of the Java Man—in the Miocene period, before the Ice Age, more than a million years ago, perhaps several million.

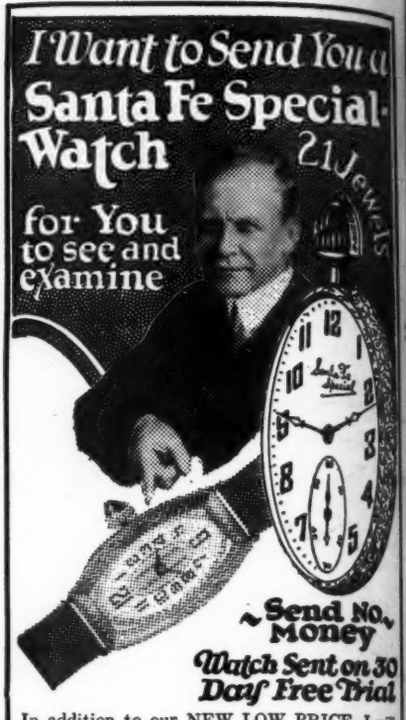
Back still farther, in Eocene time, some fifty million years or more ago, lived a strange little creature which, evolutionists believe, was the true originator of the family tree from which both man and the great anthropoids sprang. This was the tree shrew, thought to link the insect eating animals and the first primates. The tree shrew still exists in the East Indies, so little changed from its remote ancestors that it has been called "a living fossil." Later on, and representing the same transition, came the Notharctus, an early fossil ancestor of the lemur. The oldest known anthropoid ape, called Propliopithecus, is believed to have lived some 35,000,000 years ago. No larger than a small ring-tailed monkey, it bears out the evolutionary theory that small anthropoids were the forerunners of the great apes and man.

"Our inquiries are but begun," declared Keith in summarizing the evidence. "There is so much we do not yet understand. Will the day ever come when we can explain why the brain of man has made such great progress while that of his cousin, the gorilla, has fallen so far behind? Can we explain why inherited ability falls to one family and not to another; or why, in the matter of cerebral endowment, one race of mankind has fared so much better than another?"

The answers to these and other mysteries of life may be found, he suggests, in the discovery of the life processes and influences which have shaped the evolutionary histories of man and ape.

IN RECENT years much has been learned about the action of the glands and their power to effect startling changes in the human body—changes sometimes as great as the differences between one race and another. Still other discoveries have revealed how the active cells of the body, working at their tasks, are coördinated by microscopic chemical messengers, the hormones, and dispatched through the blood stream from one department of the body to another. From which Keith concludes:

"With such sources of knowledge being ever extended and others of great importance, such as the study of heredity, we are justified in the hope that man will be able in due time not only to write his own history but to explain how and why events took the course they did."



In addition to our NEW LOW PRICE, I will send for your approval one of these Standard Watches, guaranteed for a lifetime of satisfactory service, not only by the Santa Fe Watch Company, but by the Great Illinois Watch factory. So accurate, Government officials carry them; so perfect and beautiful, jewelers say they are worth 1/3 to ½ more than we ask for them. I will send you one to see WITHOUT ONE PENNY DOWN—allow you to use it 30 days FREE—then sell it to you on easy payments.

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The Popular Science Institute has prepared a booklet that gives definite and helpful advice in buying, installing and operating a radio outfit. This 20-page radio booklet can be obtained for 25 cents from the Popular Science Institute, 240 Fourth Ave., New York City.

Ⓘ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Answers to Sam Loyd Puzzles on Page 66

Alphabetical Arithmetic

The key word is DISCREPANT. Number the letters consecutively, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0, and substitute their values for the letters in the sum, when it will be seen that the translation is as follows:

52
70
16
93
48

279

Finding a Hidden Science

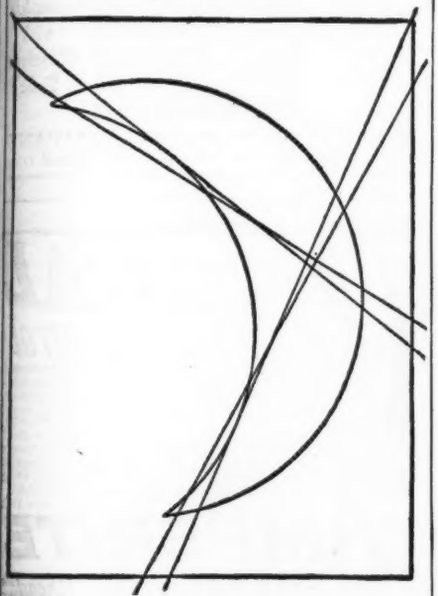
Words set down: Pitch, emigrate, strife, pantry.
Words struck out: Pit, grate, rife, pant.
Remaining word: CHEMISTRY.

Kindergarten Finance

Kitty must have had seven cents and her brother Harry five cents.

Dissecting the Moon

Four straight lines across the oblong can be made as shown in this diagram to produce fifteen segments of the crescent.

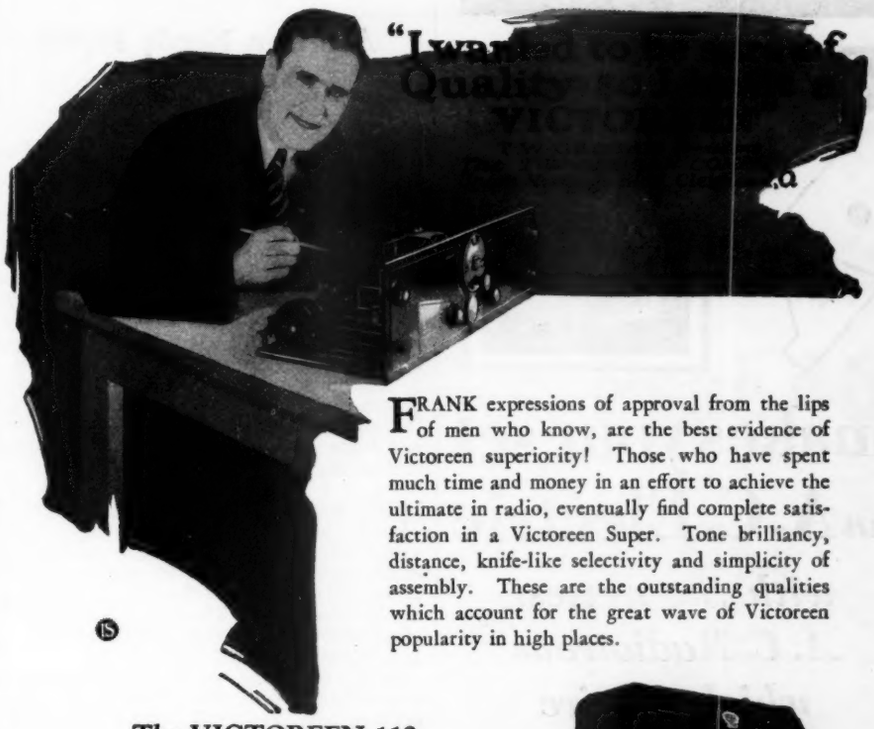


A Roman Mob

There were 21 men in that Roman mob. The stage manager's 20 supernumeraries that were "behind him" likewise were "ahead of him," since they traveled in a circle. Four fifths of 20, which is 16, added to one quarter of 20, which is 5, equals 21, the total number including the stage manager.

A Puzzling Crisscross

The diagram illustrates a three-line construction to separately pen the seven arrows.

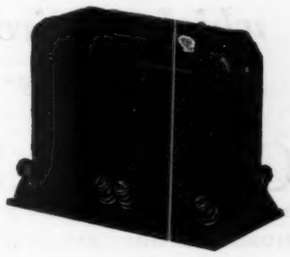


FRANK expressions of approval from the lips of men who know, are the best evidence of Victoreen superiority! Those who have spent much time and money in an effort to achieve the ultimate in radio, eventually find complete satisfaction in a Victoreen Super. Tone brilliancy, distance, knife-like selectivity and simplicity of assembly. These are the outstanding qualities which account for the great wave of Victoreen popularity in high places.

The VICTOREEN 112 AUDIO TRANSFORMER UNIT

Presenting all of the intimate naturalness of the original program, this efficient unit is designed to handle up to 400 volts of B battery supply. It is especially adapted to the Western Electric cone speaker or similar types. The transformer consists of two stages of audio amplification in one case and is designed for use with two 112 power tubes.

You can build a Victoreen "Super" and be assured of quality results. Send today for the 1928 blue print of the Victoreen circuit—there is no charge.



The G. W. Walker Company
2825 Chester Avenue Cleveland, Ohio

Victoreen

A 2c STAMP —will start you on the road to success. See Money Making Opportunities on pages 146 to 174.

REMOTE CONTROL

Mechanical Model $18.00
Electrical Model $60.00
(Add 10% west of Rocky Mts.)
Write for illustrated descriptive circular

Imagine the pleasure of tuning your radio without having to get up once all evening! Turn set "on" or "off," tune, regulate volume—**from your easy chair!** Easily attached to any single removable dial receiver in a few minutes.

ALGONQUIN ELECTRIC COMPANY, Inc.
245 Fifth Avenue, New York City

The NEW *Algonquin*
Trade Mark Reg. U. S. Pat. Off.
Remote Control Radio Tuning Unit

CARTER

NEW
"IMP" Power Switches
(for 110-Volt Circuit)

$1.50

New "IMP" Automatic Power Switch
Replaces relay. Controls any type of "A" or "B" supply. Switches off charger, "B" supply on, and closes filament circuit—3 operations in one.

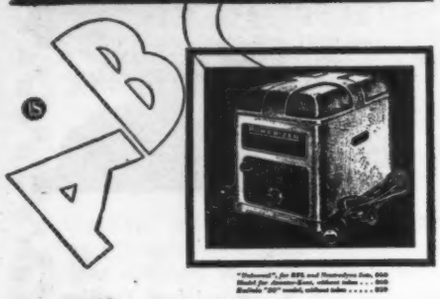
New "IMP" Power Switch
New snap switch construction for 6 volt filament or 110 volt circuit. Complete with "ON" and "OFF" name plate.

75c

Any dealer can supply.
In Canada: Carter Radio Co., Ltd., Toronto

MEMBER RMA Carter Radio Co. CHICAGO

POWERIZER



"Universal", for AFL and Transformer Sets, $60
Model for Atwater Kent, without tubes . . . $60
Radiola "20" model, without tubes $59

makes your set an A. C. Electric

with the newest A. C. Radiotrons which require no batteries

CYMBALS crash . . . the great bass booms . . . the baritone sax sighs and moans . . . dance music with jungle deep intonations . . . music such as you've never heard from your radio before . . . With the Powerizer, all those elusive low notes are captured—and reproduced with a rich mellowness.

Equip your set with a Powerizer and the finest tone quality in Radio is yours—for there is installed in your set the same system of A. C. Radiotron electrification that is used in the finest $500 and $800 A. C. Receivers.

Write for literature explaining details of how to make your radio set a modern A.C. receiver using the big oversized UX-210 tube for tone.

RADIO RECEPTOR CO., *Inc.*
106 Seventh Avenue
New York, N. Y.

Licensed by Radio Corporation of America and Associated Companies

Model for Atwater Kent, without tubes $60.00. Radiotrons UX-280 and UX-210, $14.00.

Radiola "20" Model—List without tubes $59.00. Radiotrons UX-280 and UX-210, $14.00.

Aviation Needs 10,000 Young Men

(*Continued from page 44*)

translated into audible signals which the flyer can pick up. That is a fertile field for study by electrical engineers."

There are opportunities for civil engineers who know something of aviation and its problems, in laying out and building airports. There are only thirty-one completely equipped airports in America; there will be a need for several hundred in five years, and to build, equip and operate these airports is going to require the services of thousands of men.

"The biggest present need and the widest opportunity today is in getting business for the air transport lines already in operation and being organized," Frank Tichenor, editor of Aero Digest, told me.

THE newspapers have given columns of space to the experiment of the Royal Typewriter Company in delivering typewriters to customers by airplane. The novelty of such things will wear off, and the papers will cease to regard them as news. Then the young men with ideas about advertising and knowledge of aviation will have their chance.

It isn't easy to get passengers for airplanes, at least in the East. The air passenger service between New York and Boston was discontinued early in August, partly because men are afraid to risk their lives, not realizing that air travel is immensely safer than it used to be and getting safer all the time.

That is quite human and natural. The first Cornelius Vanderbilt, who later became the railroad king of America, refused to ride on a railroad train for more than twenty years after having been hurt in an accident on the first railroad built in the United States. Now twenty-five cents a day will buy a $5,000 accident insurance policy for railroad travelers, so safe have railroads become. The same thing will happen in respect to air travel. Half a dozen insurance companies are now offering air policies, some at very low rates. I can see opportunities for a great many enterprising young men, selling air insurance, on commodities as well as on lives.

Airplane mechanics are scarce, and the demand is growing. The Department of Commerce has ruled that none but licensed mechanics may repair or overhaul a licensed plane.

"An engine mechanic," says the Government manual of Air Commerce Regulations, "will be licensed upon passing an examination showing that he has sufficient knowledge of internal combustion engines, electricity, and power plant of airplane types, and can properly inspect, repair, and overhaul airplane engines." And an airplane mechanic must pass an examination proving he is qualified "in plane structure, rigging, and control, and can properly inspect, repair, and overhaul airplane structures."

I WATCHED a young man at one of the flying fields tinkering with an airplane engine, a few weeks ago. "Have you got your Government license yet?" I asked him.

"Sure," he grinned, displaying his license card. "Why, I was just naturally handy with tools, and crazy about flying, so I came down here to learn to fly. My money gave out and I had to go to work. They found a place for me at $6 a week helping at all sorts of odd jobs. That was three years ago. Now I'm doing the fine work on the best engines. I used to work all day and study engine design all night. Some day I'm going to try out an engine of my own; I'm working on the patterns now."

"But how do you learn to fly, and what opportunities are there for the flying man who simply *can't* stay on the ground?"

Anybody can learn to fly. You can't become a military aviator (*Continued on page 143*)

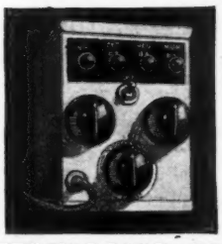
Light Socket Power *is within your reach*

WHEN you buy a Sterling "B" Power Unit, you get *power regulation* which means tone quality at its best. You get power for any set having 4 to 8 tubes including a power tube. You get light socket convenience and the utmost in reliability. At the remarkably low price of $28.50, Sterling "B" Power Units are within the reach of every purse.

A Sterling demonstration will be a revelation. Any Sterling dealer will be glad to prove it.

Sterling
"B" Socket Power

Model R-81 "B" Power for sets from 4 to 8 tubes



Price $28.50 *complete with Raytheon Tube*

THE STERLING MFG. COMPANY
2831 Prospect Avenue . . . . . Cleveland, Ohio

The LOGICAL Filament Control

AMPERITE is the only **self-variable** filament control. Automatically does the work of hand rheostats and delicate meters. Proved for 6 years. Specified in every circuit. Entirely different from fixed filament resistors. Accept nothing but AMPERITE.

FREE—"Amperite Book" of the season's best circuits and latest construction data. Write Dept. VS-13
RADIALL COMPANY
50 Franklin St., New York

AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" Rheostat

BIG RADIO CATALOG
From the "Big, Friendly Radio House"

NEW 1928 Book offers finest, newest well-known sets; parts, eliminators, accessories at lowest prices. Dealers, set-builders, agents—WRITE for this CATALOG!

Western Radio Mfg. Co.
130 West Lake St., Dept. 29—CHICAGO

Make More Money

Read the Money Making Opportunities on pages 146 to 174 of this issue.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Aviation Needs 10,000 Young Men

(*Continued from page 142*)

unless you are a practically perfect physical specimen. You can't get a first class Government license as a civilian airman if there is anything wrong with your heart, lungs, kidneys, digestive apparatus, throat, nose, ear or eyes. But you can learn to fly an airplane if you are able to drive an automobile.

A twelve-year-old boy, Frank Reppingille, in Detroit, has made solo flights. Farnam Parker, fourteen, of Anderson, Indiana, holds a pilot's license from the Federation Aeronautique Internationale, which was the only source of pilot's licenses in America until the United States Government began to issue them at the beginning of this year. The Government's minimum age for granting a license is sixteen, and there is no maximum. J. W. Montee, who flew from California to New York not long ago, is more than sixty. Captain H. I. Willoughby of Newport is still flying his own plane for the sport of it, at sixty-eight. Anybody can learn to fly.

THE best teacher of all is Uncle Sam, but since it costs the Government about $55,000 a head to train aviators, the Army, Navy and Marine Corps are rather particular about the sort of material they accept to start on. Even so, three quarters of those who start never become sufficiently expert to qualify for military service. But the Government does not insist upon the graduates of Kelly Field remaining in the service. They can go into civil aviation, and so become part of the Army's second line of air defense. And when a pilot has finished his year's course—half a year at either Brooks Field, San Antonio, or Marsh Field, Riverside, Calif., and the rest at Kelly Field—he knows how to fly anything that *can* fly.

To get a chance to learn at Uncle Sam's expense the candidate must be unmarried, between the ages of twenty and twenty-seven, practically perfect physically, and with two years of college or its equivalent behind him. The men who today are holding the best jobs in commercial aviation, as air mail pilots, air surveyors, heading exploring expeditions, are almost without exception graduates of Kelly Field or of the other war-time training fields.

There are three other ways of learning to fly: hiring or persuading some expert flyer who has his own plane to teach you, joining a flying club, and entering one of the aviation schools, of which there are possibly a hundred in different parts of the country.

The flying club is a revival of the earliest of all methods of learning to fly. The very first airplane ever sold by its maker was bought by the Aero Club of New York from Glenn Curtiss in 1909, and with it many who later became famous in aviation learned to fly at Mineola. To start a flying club a number of would-be aviators combine to buy a plane for anywhere from $750 to $2,000 or more, engage the whole or part time services of a pilot as instructor, and take their turns at lessons.

THE vast majority of those who are now beginning to qualify for careers in commercial aviation are students in the regular schools of flying. I recently visited one of the oldest, which has graduated more than 500 flyers, without a single accident to a student.

"We give them ten hours in the air, and a complete course in the elements of plane construction and repair, for $300," said the chief instructor, who himself flew in the war and taught many Army men to fly.

"We don't set up any rigid physical standards," he went on, "but we watch them carefully, and if a student doesn't show that he has the makings of an airman in him we give him his money back and wish him luck at something else."

(*Continued on page 144*)

FREE To Men Past 40

A WELL-KNOWN scientist's new book about old age reveals facts, which, to many men, will be amazing. Did you know that two-thirds of all men past middle age are said to have a certain seldom mentioned disorder? Do you know the frequent cause of this decline in vitality?

Common Old Age Symptoms

Medical men know this condition as hypertrophy of the prostate gland. Science now reveals that this swollen gland—painless in itself—not only often cheats men of vitality, but also bears on the bladder and is often directly responsible for sciatica, backache, pains in the legs and feet, frequent nightly risings, and dizziness denoting high blood pressure. When allowed to run on it is frequently the cause of the dreaded disease cystitis, a very severe bladder inflammation.

65% Have This Gland Disorder

Prostate trouble is now reached immediately by a new kind of home treatment—a new, safe hygiene that goes directly to the gland itself, without drugs, medicine, massage, lessons, diet or the application of electricity. It is absolutely safe. 40,000 men have used it to restore the prostate gland to normal functioning. The principle involved in this treatment is recommended by practically all the physicians in America.

Amazing recoveries are often made in six days. Another grateful effect is usually the immediate disappearance of chronic constipation. Usually the entire body is toned up, as much of your youthful vigor is restored. These results are guaranteed. Either you feel ten years younger in six days or the treatment costs nothing.

Send for FREE Book

If you have this gland trouble or if you have any of the symptoms mentioned above, you should not lose a day in writing for the scientitist's free Book, "Why Many Men Are Old At 40." It will enable you to ask yourself certain frank questions that reveal your true condition. Every man past 40 should make this test, as insidious prostate disorder often leads to surgery. This book is absolutely free, but mail coupon immediately, as the edition is limited. Address

THE ELECTRO THERMAL COMPANY
4076 Main Street, Steubenville, Ohio.

If you live West of the Rockies, mail your inquiry to The Electro Thermal Co., Suite 40-V, 303 Van Nuys Bldg., Los Angeles, Calif.

THE ELECTRO THERMAL COMPANY,
4076 Main Street, Steubenville, O.

Please send me FREE and without obligation, a copy of your booklet, "Why Many Men Are Old at 40." Mail in plain wrapper.

Name.....

Address.....

City.....State.....

The Electrician's Wiring Manual

By F. E. SENGSTOCK, E. E.

Contains all the information needed for the proper installation of lighting and power systems in houses and other buildings.

It completely covers inside electrical wiring and construction in accordance with the National Electric Code. *Pocket size—flexible binding*

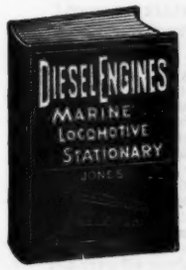
448 pp. Price, $2.50

POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

DIESEL ENGINES

Marine and Stationary

By ENSIGN DAVID L. JONES, U. S. Navy



The most complete, thoroughly practical and up-to-date treatise on the Diesel Engine ever published. It explains their construction troubles, remedies, operation and adjustments, practical trials and tests and the elementary thermodynamics of all types of the Diesel Engine. The book is fully illustrated with drawings of working parts and detail engravings. 400 pages.

Price, $5.00

Popular Science Monthly
250 Fourth Ave. New York, N. Y.

10 DAYS FREE TRIAL — MONEY BACK IF NOT SATISFIED

THE NEW IMPROVED **INKOGRAPH** SELF FILLER
GREATEST VALUE EVER OFFERED

SAME SIZE AS $7 & $8.75 Fountain Pens

The Perfect Writing Instrument $1.50

Writes with ink free and easy as a lead pencil, without a miss, skip or blur. Its steady uniform flow of ink actually improves your handwriting. Won't blot, scratch, leak, or soil hands.

Makes 3 or 4 Carbon Copies With Original In Ink.

Anyone can write with your Inkograph, no style of writing or pressure can bend, spread, injure or distort its 14 kt. gold point.

That hard, smooth, round, ball-like point, which glides with ease over the coarsest paper and makes possible writing in ink as rapidly as with the softest lead pencil

Patent Automatic 14kt. gold feed prevents clogging. Made of best grade, highly polished, hard rubber, highest class workmanship. Pocket clip attached makes it an instrument of refinement. We know you will prefer an Inkograph to any writing instrument once you try it. SEND NO MONEY. Pay postman $1.50 plus postage. Year's guarantee certificate assures absolute satisfaction. Write name and address plainly.

The Pencil Pointed Pen

INKOGRAPH CO., Inc., 199-285 Centre St., New York

AGENTS Sell Inkographs, make bigger profits, more sales, without investment. Quicker commissions, popular prices, no collecting, no competition. Send for an Inkograph or write for special sales plan booklet.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The HAMMARLUND "Midline"

A Radio Condenser You Can Rely On

HAMMARLUND Condensers always have been as near perfect as advanced engineering could make them. The new "Midline" is quite the best of a long series of Hammarlund Condenser achievements.

It embodies every feature of proved worth, plus a precision of manufacture that makes it easily the leader in its field. The "Midline" will last long and serve faithfully——And it costs no more than the other kind.

Write For Folder

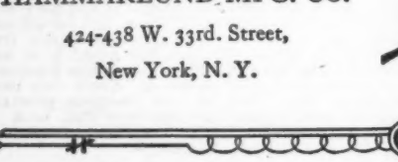
HAMMARLUND MFG. CO.
424-438 W. 33rd. Street,
New York, N. Y.

Your Dealer Sells It

For Better Radio
Hammarlund
PRECISION
PRODUCTS

An Authority Tells How To Buy, Install and Operate A Radio For Best Results

The Radio Buyer who follows the instructions contained in the new 20-page radio booklet published by the Popular Science Institute will get 100 percent satisfaction out of his investment and avoid mistakes. Send 25 cents to Popular Science Institute, 246 Fourth Avenue, New York City.



Training gets men ahead in AVIATION

At home, in your spare time, you can learn the fundamentals of Aviation—and start yourself on the way to large earnings

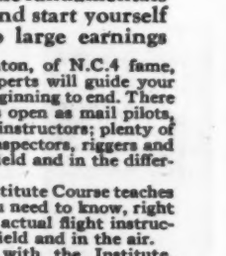
Lieut. Walter Hinton, of N.C.4 fame, and his staff of experts will guide your instruction from beginning to end. There are many positions open as mail pilots, commercial flyers, instructors; plenty of well paid jobs as inspectors, riggers and mechanics on the field and in the different factories.

The Aviation Institute Course teaches you everything you need to know, right up to the point of actual flight instruction on the flying field and in the air.

In cooperation with the Institute, flying instructions are given all over the United States, at reasonable rates.

Get all the facts about the Institute course and the way it leads to Opportunity. Do it now,

FREE *This Book Tells All*



Aviation Institute of U. S. A.

Walter Hinton, Pres.

Aviation Institute of U. S. A., Suite 212
1115 Connecticut Ave., N. W. Washington, D. C.

You may send me without obligation a Free copy of "Aviation—the opportunity of to-day."

Name.....

Age (not under 16).....

Street.....

City.....State.....

MAKES A COMPLETE MACHINE SHOP

EVRY-USE ELECTRIC MOTOR ATTACHMENT

ONLY $3.95

Fastens on shaft of small motor in a jiffy. Holds attachments for Grinding, Polishing, Sawing, Drilling, etc.

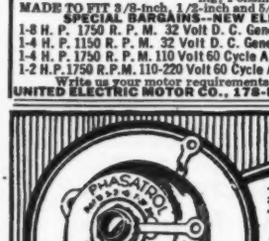
MADE TO FIT 3/8-inch, 1/2-inch and 5/8-inch shafts. State size.

SPECIAL BARGAINS—NEW ELECTRIC MOTORS

1-8 H. P. 1750 R. P. M. 32 Volt D. C. General Electric.....$10.50
1-4 H. P. 1150 R. P. M. 32 Volt D. C. General Electric.....14.75
1-4 H. P. 1750 R. P. M. 110 Volt 60 Cycle A. C. Day-Fan Electric 12.00
1-2 H.P. 1750 R.P.M. 110-220 Volt 60 Cycle A.C. Day-Fan Electric 29.75

Write us your motor requirements for other bargains.

UNITED ELECTRIC MOTOR CO., 178-D1 Centre St., New York



Licensed by Rider Radio Corporation
Pats. Pending
Pat'd 5-2-'16; 7-27-'26

Here's An Oscillation-Eliminator!

PHASATROLS

Reg. U. S. Pat. Off.

Price $2.75

A True Balancing Device for All Radio Frequency Amplifiers

Bring the set you've built, or the set you own, up-to-date with PHASATROLS. This startling new Electrad device stops oscillation squeals and distortion in any R. F. set.

PHASATROLS make tuning easy and prevent radiation interference to your neighbors. No technical knowledge needed to install.

Write for free hook-up circular for any set or circuit.

AT GOOD DEALERS

Dept. 64C 175 Varick St. New York, N.Y

ELECTRAD, Inc.

Aviation Needs 10,000 Young Men

(Continued from page 143)

The course here takes from four to six weeks. The ten hours in the air is given in broken doses, of twenty minutes each, so that the student actually makes thirty flights.

Training is given in the old-fashioned "Jennies," the Curtiss JN4D's in which probably two thirds of our war flyers got their first training. These are small biplanes, equipped with ninety-horsepower engines, and having two cockpits, each provided with controls.

The instructor sits in the forward cockpit, the student in the after one.

"Keep your feet on the rudder bar and your hand on the control stick, but I'll do the steering," says the instructor. "Let your hands and feet be guided by the controls, instead of trying to guide them, and see what the ship does when I move either of them. And don't try to talk to me while we're in the air, because I can't hear you. Keep your safety belt fastened and don't get rattled. I'll bring you back all right."

AFTER a few flights with the instructor alone in control, he gradually lets the student guide the craft in the air, often without letting him know that he is doing it.

When the student has finished his course at one of the private aviation schools, he still has a lot of flying experience to gain before he can get a Government license as air pilot. And if he is going to make the flying end his part of the aviation game, he *must* have a pilot's license—an industrial, limited commercial or transport license.

It takes fifty hours of solo flying, that is, flying in complete command and control of the plane, to qualify for an industrial or limited commercial license; 200 hours for a transport pilot. Only transport pilots are allowed to carry passengers or mail, except that the holder of a limited commercial license may take up passengers for short flights over a limited area, specified in his license. Industrial pilots may carry express matter but not passengers or mail, and private pilots may not carry either passengers or property for hire. A new form of private license, known as "student's license," has lately been established by the Department of Commerce, to let any actual flying student use a licensed plane while learning. The limited commercial license is calculated to enable the student, after he has got in fifty hours of solo flying, to make a living while getting in the remaining 150 hours necessary to qualify him for the transport license, the highest grade.

But to get in that first fifty hours of solo flying, the student must exercise some ingenuity or spend a good deal of money.

"WE RENT planes for solo flying, to our graduates, for $25 an hour," said the head of a school. Some of them work out that cost, or part of it, in various jobs around the field. Some buy cheap planes for practice. Those who can otherwise qualify for the Air Reserve, either as graduates of the Reserve Officers Training Corps or as having had two years of college, can get some help from the Government in this part of their work, being permitted, after acceptance and enrollment in the Air Reserve, to use Government planes for a limited number of hours a month."

There are correspondence schools teaching the theoretical part of aviation—some of them quite thoroughly—and some have arrangements with practical flying schools whereby their students get a reduction in rates for that part of their instruction. But in general it costs from $1,000 upward, and takes the best part of a year of elapsed time.

There will be more than ten thousand opportunities for young men in aviation before long, but the "lucky" ones who will seize them will be the wise ones who begin to qualify now.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"Can he really play?" a girl whispered. "Heavens, no!" Arthur exclaimed. "He never played a note in his life."

They Laughed When I Sat Down At the Piano But When I Started to Play!—

ARTHUR had just played "The Rosary." The room rang with applause. I decided that this would be a dramatic moment for me to make my debut. To the amazement of all my friends I strode confidently over to the piano and sat down.

"Jack is up to his old tricks," somebody chuckled. The crowd laughed. They were all certain that I couldn't play a single note.

"Can he really play?" I heard a girl whisper to Arthur. "Heavens, no!" Arthur exclaimed. "He never played a note in all his life... But just you watch him. This is going to be good."

I decided to make the most of the situation. With mock dignity I drew out a silk handkerchief and lightly dusted off the keys. Then I rose and gave the revolving piano stool a quarter of a turn, just as I had seen an imitator of Paderewski do in a vaudeville sketch.

"What do you think of his execution?" called a voice from the rear.

"We're in favor of it!" came back the answer, and the crowd rocked with laughter.

Then I Started to Play

Instantly a tense silence fell on the guests. The laughter died on their lips as if by magic. I played through the first bars of Liszt's immortal Liebesträume. I heard gasps of amazement. My friends sat breathless—spellbound.

I played on and as I played I forgot the people around me. I forgot the hour, the place, the breathless listeners. The little world I lived in seemed to fade—seemed to grow dim—unreal. Only the music was real. Only the music and the visions it brought me. Visions as beautiful and as changing as the wind-blown clouds and drifting moonlight, that long ago inspired the master composer. It seemed as if the master musician himself were speaking to me—speaking through the medium of music—not in words but in chords. Not in sentences but in exquisite melodies.

A Complete Triumph!

As the last notes of the Liebesträume died away, the room resounded with a sudden roar of applause. I found myself surrounded by excited faces. How my friends carried on! Men shook my hand—wildly congratulated me—pounded me on the back in their enthusiasm! Everybody was exclaiming with delight—plying me with rapid questions.... "Jack! Why didn't you tell us you could play like that?" ..."Where *did* you learn?"—"How long have you studied?"—"Who *was* your teacher?"

"I have never even *seen* my teacher," I replied. "And just a short while ago I couldn't play a note."

"Quit your kidding," laughed Arthur, himself an accomplished pianist. "You've been studying for years. I can tell."

"I have been studying only a short while," I insisted. "I decided to keep it a secret so that I could surprise all you folks."

Then I told them the whole story.

"Have you ever heard of the U. S. School of Music?" I asked. A few of my friends nodded. "That's a correspondence school, isn't it?" they exclaimed.

"Exactly," I replied. "They have a new simplified method that can teach you to play any instrument *by note* in just a few months."

How I Learned to Play Without a Teacher

And then I explained how for years I had longed to play the piano.

"It seems just a short while ago," I continued, "that I saw an interesting ad of the U. S. School of Music mentioning a new method of learning to play which only cost a few cents a day! The ad told how a woman had mastered the piano in her spare time at home—and *without a teacher!* Best of all, the wonderful new method she used required no laborious scales—no heartless exercises—no tiresome practising. It sounded so convincing that I filled out the coupon requesting the Free Demonstration Lesson.

"The free book arrived promptly and I started in that very night to study the Demonstration Lesson. I was amazed to see how easy it was to play this new way. Then I sent for the course.

"When the course arrived I found it was just as the ad said—as easy as A. B. C.! And as the lessons continued they got easier and easier. Before I knew it I was playing all the pieces I liked best. Nothing stopped me. I could play ballads or classical numbers or jazz, all with equal ease. And I never did have any special talent for music."

* * * *

Play Any Instrument

You, too, can now *teach yourself* to be an accomplished musician—right at home—in half the usual time. You can't go wrong with this simple new method which has already shown almost half a million people how to play their favorite instruments *by note*. Forget that old-fashioned idea that you need special "talent." Just read the list of instruments in the panel, decide which one you want to play and the U. S. School will do the rest. And bear in mind no matter which instrument you choose, the cost in each case will be the same—just a few cents a day. No matter whether you are a mere beginner or already a good performer, you will be interested in learning about this new and wonderful method.

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Have you above instrument?.....

Name.....
(Please write plainly)

Address.....

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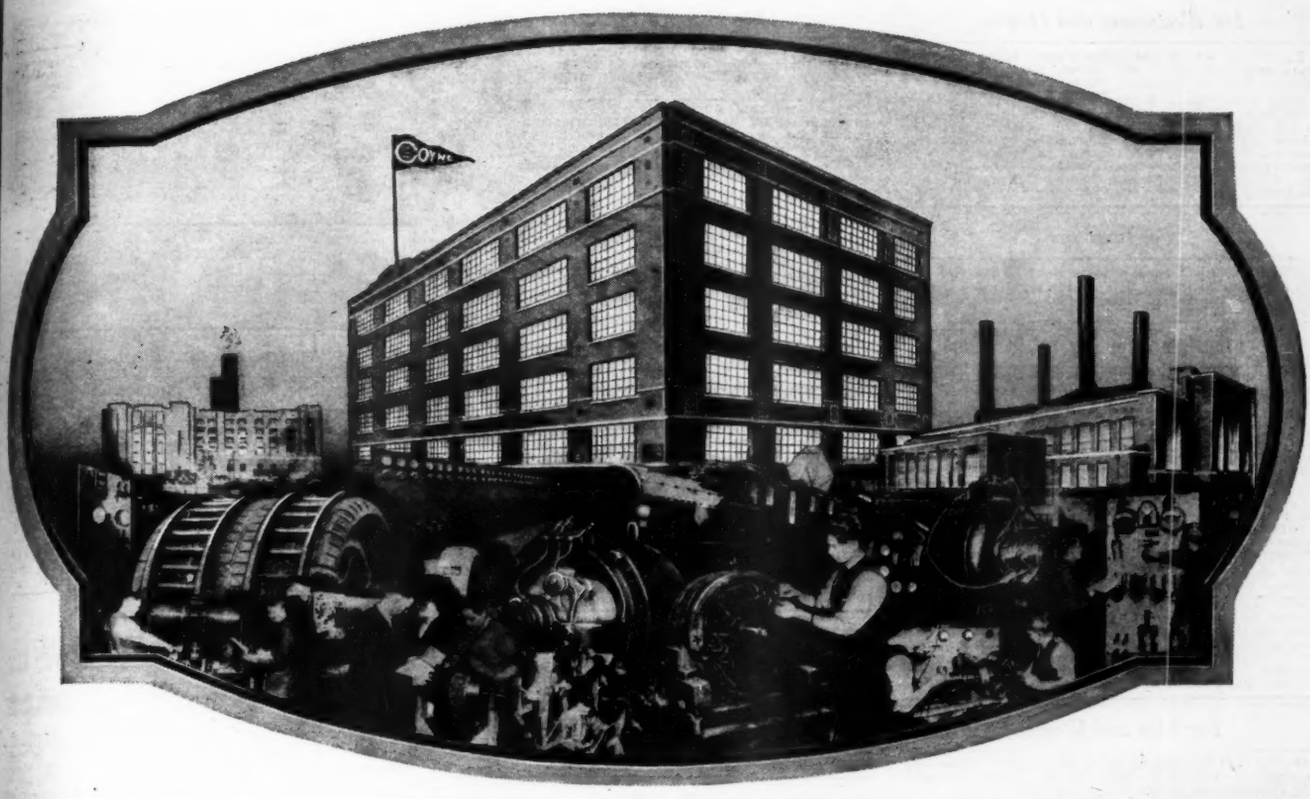

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MODEL steam engines and boilers. Boat and boiler fittings. Send 10c stamp for catalog. Refunded with first order. Model Machine Shop. 212 Price St., Rahway, New Jersey.

SHIP Models: Complete parts and blueprints for Three Masted Chinese Junk, 60c postpaid. Casson-Craft, Framingham, Mass.

LET our experience be your guide. Models that are models: Tools and equipment for economic manfg. Patterns of all types; manufacturing in all branches. Satisfaction guaranteed. United Machinery Company, Engineering Dept., Cincinnati, U. S. A.

Models and Model Supplies

SHIP Model Fittings: Steering Wheels, Capstans, Anchors, Propellers, etc. Send stamp for booklet. A. J. Fisher, 1002 Etowah Ave., Royal Oak, Mich.

EVERYTHING for Ship Models. Catalog, dime. Roy Hancock, 323 Douglas Ave., Portsmouth, Va.

IMPORTANT to advertisers! Are you deriving profit from your advertising? Write today for a copy of the "Quick-Action Advertising Rate Folder" showing "How You Can Use Popular Science Monthly Profitably." Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Motorcycles

MOTORCYCLE bargains. Used, rebuilt. Guaranteed. Shipped on approval. Catalog free. Floyd Clymer, 812 Broadway, Denver, Colo.

Moving Picture Business

"BE A Movie Exhibitor"—Big Opportunity Only Moderate Capital Required—Complete Equipment at Remarkably Low Prices. Write, Atlas Moving Picture Co., 624 South Michigan Ave., Chicago, Ill.

Music and Musical Instruments

SAXOPHONISTS — Clarinetists — Cornetists — Trombonists—get "Free Pointers." Virtuoso Music School, 36, Buffalo, N. Y.

SHEET-MUSIC, 10 for $1.00. For Amateur Teacher or Student. Catalog free. Ferd. Zarb, P. O. B. 18, Sta. D,, New York.

Novelties and Pictures

ART Pictures, Books and Novelties. Catalog 10c. Howard Sales Co., Dept. 3, 1188 Folsom St., San Francisco, Calif.

PHOTO art novelties, books, magazines, foreign publications. Catalog free. Villaverde Co., Box 1329, Havana, Cuba.

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Office Devices

ADDRESSING machines, multigraph, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 117 N. Market St., Chicago.

ALL Advertisers should not be without the important facts on Money Making. Write today for the "Quick-Action Advertising Rate Folder" which contains information of value to you. If you are anxious for quick profit returns, do it now! Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Patent Attorneys

PATENTS—Time counts in applying for patents. Don't risk delay in protecting your ideas. Send sketch or model for instructions or write for FREE book, "How to Obtain a Patent" and "Record of Invention" form. No charge for information on how to proceed. Communications strictly confidential. Prompt, careful, efficient service. Clarence A. O'Brien, Registered Patent Attorney, Security Bank Building (directly across street from Patent Office), Washington, D. C. (See page 161)

PATENTS. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 724 9th Street, Washington, D. C.

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MONROE E. MILLER, Ouray Bldg., Washington, D. C., Patent Lawyer, Mechanical, Electrical Expert. Booklet and Priority Record blank gratis.

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PATENT, trade-marks, copyrights. Reliable services by an experienced practitioner devoting personal attention to each case. Inquiries invited. References furnished. B. P. Fishburne, Patent Lawyer. 525-C McGill Building, Washington, D. C.

LANCASTER AND ALLWINE, 232 Ouray Building, Washington, D. C. "Originators of the Form Evidence of Conception." Before disclosing your invention to anyone send for blank form to be signed and witnessed. Form and patent information bulletin free.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

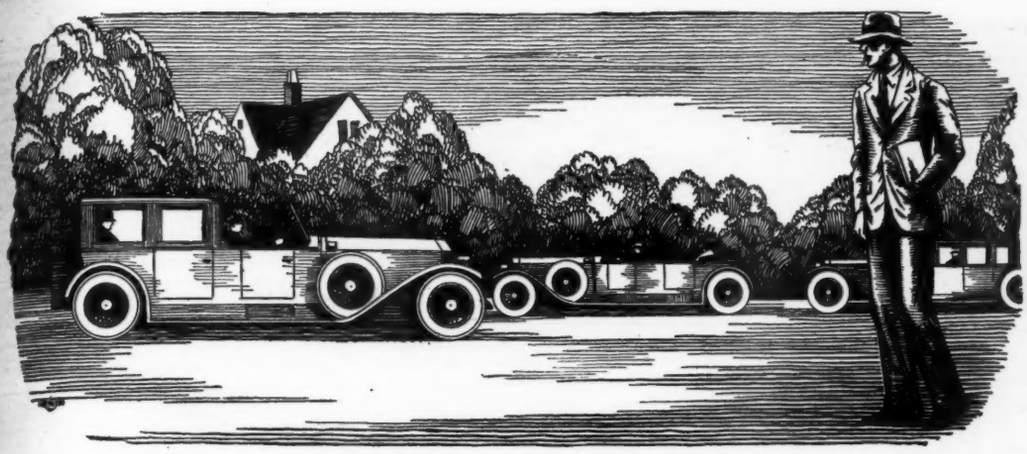
INVENTOR'S Advisor, valuable patent book, sent free. Lebiner, Three Parkrow, New York.

PATENTS. Free advice, personal service of registered Attorney, former Patent Office Examiner. Booklet. Albert Jacobs, 725 Barrister Bldg., Washington.

ADAM E. FISHER, Registered Patent Attorney in business 25 years; references; personal attention and promptness assured; Dept. E, 183 Enright, St. Louis, Mo.

INVENTORS' Guide free on request; gives valuable information and advice for all who have original ideas or improvements. Frank L. Lederman, Registered Attorney and Engineer, Woolworth Bldg., 1714, New York.

PATENTS secured. Easy terms. Inventors' Service Bureau, Box 1648, Washington.



Many times in the old days while I trudged home after work to save carfare, I used to gaze enviously at the shining cars gliding by me, the prosperous men and women within. Little did I think that inside of a year, I too, would have my own car, a decent bank account, the good things of life that make it worth living.

I Thought Success Was For Others

Believe It Or Not, Just Twelve Months Ago I Was Next Thing To "Down-and-Out"

TODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my banker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home!"

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

I WAS a clerk working at the usual miserable salary such jobs pay. Somehow I'd never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—but it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but *what* line? I've always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle." Mary didn't seem to be satisfied with the answer but I didn't know what else to tell her.

It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself, a few burning words that were the cause of the turning point in my life!

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me!

"Bargain counter shiek—look how that suit fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh, it's just 'Useless' Anderson," said another. "He's got a wish-bone where his back-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance?" *Did Mary secretly think that too?* And after all, wasn't it *true* that I had a "wish-bone" where my back-bone ought to be? Wasn't that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the table, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

WHAT'S happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, *I've had a Radio business of my own!* At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

NOW I'm making real money. I drive a good looking car of my own. Mary and I don't own the house in full yet, but I've made a substantial down payment, and I'm not straining myself any to meet the installments.

Here's a real tip. You may not be as bad off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be *doing* something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well-paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. P-87, Washington, D. C.

J. E. Smith, President,
National Radio Institute,
Dept. P-87, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesmen will call on me.

Name.....

Address.....

Town.....State.....

Patent Attorneys

INVENTORS who derive largest profits know and heed certain simple but vital facts before applying for patents. Our book "Patent Sense" gives those facts; free. Lacey & Lacey, 648 F. St., Washington, D. C., Established 1869.

PATENTS Procured. Trade Marks Registered.—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D. C., or 41-Z Park Row, New York.

CARL MILLER, Registered Patent Attorney, (former Patent Office examiner), McGill Building, Washington, D. C. Write for Instructions.

BROCHURE "How to Get a Patent," FREE. Send rough ideas or sketch. No obligation. Prompt expert co-operation. A. L. Applebaum, Registered Patent Attorney, 41 Park Row, New York. Formerly Assistant Examiner U. S. Patent Office.

INVENTORS: Consult Edgar M. Kitchin, Specialist on Patents and Trade Marks also Attorney and Counsellor at Law. 805 G Street, N. W., Washington, D. C.

Patents for Sale

INVENTORS: Use our special service for presenting your invention or patent to manufacturers. Adam Fisher Mfg. Co., 183-A Enright, St. Louis, Mo.

OUTRIGHT Canadian patents for new motor vehicle traffic signal device operated from steering wheel. Arthur D. Roberts, 276 Bourgenis St., Montreal, Canada.

HIGHLY profitable metal automobile accessory. Sales tests remarkable. Terms to suit. Ace, 154 No. 7th St., Brooklyn, N. Y.

Photographs and Supplies

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 117 Camera House, Boston, 17, Massachusetts.

MAKE money in Photography. Learn quickly at home. Spare or full time. New Plan. Nothing like it. Experience unnecessary. American School of Photography, Dept. 1743, 3601 Michigan Avenue, Chicago.

Photoplays Wanted

$1250.00 FOR a Photoplay story by an unknown writer and sold through our Sales Department. We revise copyright and market. Located in the heart of Motion Picture Industry. We know the demand. Established 1917. Send Manuscript for free criticism. Booklet mailed on request. Universal Scenario Company, 214 Western & Santa Monica Bldg., Hollywood, Calif.

Printing and Engraving

BETTER Printing for Less Money. Write us about your printing needs, and you will save money. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

200 LETTERHEADS, 7x10, $2.00 and 100 Envelopes, postpaid. Fine quality Bond Paper. Your name and address printed on each sheet and envelope. Enclose price with order. Elmer Legg Printing Co., 5th Floor, Graphic Arts Bldg., Kansas City, Mo.

THOUSAND Hammermill Bond letterheads four dollars; Multigraphing, two. Miscellaneous printing. Mayray, Monmouth, Illinois.

PUBLISH Your Own Magazine or House Organ. Our standardized service at one-fifth ordinary prices. Samples and particulars free. Evans Printing Company, Grand Rapids, Mich.

500 FULL-SIZE Bond Letterheads: 250 Envelopes (printed) $3.00 Delivered. Gordon Co., 211-213 Main St., Buffalo, N. Y.

200 LETTERHEADS and 100 envelopes, $1.00, postpaid. Oberman Company, Box 1268, Chicago.

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Rabbits

MAKE big profits with Chinchilla Rabbits, Real Money Makers. Write for facts. Conrad's, 860 Conrad's Ranch, Denver, Colorado.

Real Estate—Orchards—Farm Lands

PECAN—Orange—Fig Groves "On the Gulf." Monthly payments. Guaranteed care. Big, quick returns. Suburban Orchards, Dept. "S," Biloxi, Miss.

OZARKS—10 acres near White River and proposed power dam, $100, $5 monthly. Alva Zimmerman, 1802 N. 5th, Kansas City, Kans.

LAND Free if planted to bananas. Bananas bear a full crop the second year. $5.00 monthly will plant five acres, which should pay $1,500 profit annually. Reliable Companies will cultivate and market your bananas for ½. Bananas ripen every day and you get your check every 90 days. For particulars address Jantha Plantation Co., Empire Building, Block 963, Pittsburgh, Pa.

Salesmen and Agents Wanted

AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Bldg., New York.

GET our free sample case, toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F., St. Louis, Missouri.

AGENTS. $60—$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A. N. Clark, Chicago.

$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

Salesmen and Agents Wanted

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amason Rubber Co., 504 Amason Building, Philadelphia, Pennsylvania.

A BUSINESS of your own—Making Sparkling Glass Name and Number Plates, Checkerboards, Signs. Big Book and Sample free. E. Palmer, 513, Wooster, Ohio.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

EARN $10 daily silvering mirrors, plating and refinishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. F. Decie Laboratories, 225 Varick Street, New York.

AGENTS: Make $500.00 Monthly. Pay daily. No investment. Rhinestone initial buckles and novelties. Sell easy everywhere. Exclusive territory. Chaton Novelty Co., 606 Blue Island, Chicago.

DON'T sell for others. Employ agents yourself. Make your own products. Toilet articles, household specialties, etc. 500% profit. We furnish everything and show you how. Valuable booklet free. Write at once. National Scientific Laboratories, 1907W Broad, Richmond, Va.

CALIFORNIA perfumed beads selling like hot cakes. Agents coining money. Big profits. Catalog free. Mission Factory, R 2328 W. Pico, Los Angeles, Calif.

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MISTER Agent let me tell you how to make the World's Biggest-selling Specialties as, Sealatite, puncture-proofing liquid for tires; Solvit Hand Cleaner; Mendit, Fabric Patching Liquid; Cellu-lac Automobile Finish—all colors; Bugacide, Fly-killing Spray; Non-Thermic Ice Saving Cloth; Tufnit, for quadrupling life of Silk Hosiery; Ducopol Guaranteed Most Efficient Automobile Polish. Fifty other equally Big Money-Makers. Investment Small. Profits Great! Let me tell you how to get the profit you're entitled to. Miller, Industrial Chemist, Miller Chemical Building, Tampa, Florida.

AT LAST! Reasonable priced Auto Emblems for every Lodge. Sells for only $1.25. Write for attractive selling proposition and FREE sample case offer. North Central Distributors, Department 10, Ashland, Ohio.

JUST Out—New Patented Apron. No strings or straps—$20.00 a day every day; over 100% profit; commissions daily. Write for free offer. Sta-Put Co., Dept. 912, St. Louis, Mo.

FROM the Argentine, South America. Latest Novelty, marvelous sales possibility, most unusual, write for full particulars. Write Don Francis X. Cassera, Dept. 117, 23 Washington St., New York City.

BIG bunch mail. Year 15c. Magazines, catalogues. Kentucky Agency, Covington, Kentucky.

BIG pay every day! Complete guaranteed line direct to wearer—Dress Shirts, Work Shirts, Flannels, Overalls, Pants, Leather Coats, Sweaters, Playsuits, $10-$25 daily! Experience unnecessary. Big Outfit Free! Nimrod Co., Dept. 25, 4922-28 Lincoln Ave., Chicago.

GOLD leaf window letters and script signs. No experience: 500% profit. Samples free. Consolidated, 69-Y-West Van Buren, Chicago.

WONDERFUL new moisture gas saver. All cars. 400% profits. Doubles Mileage. 1 free. Critchlow, A1-120, Wheaton, Ill.

LAMB'S Wool polishing mittens, brushes. Newhall, 358 Broad, Lynn, Mass.

BIG winner for Agents. New patented cigarette case. Holds package cigarettes and box safety matches; beautiful, compact, flexible container; large profits; write for liberal proposition. All-In-One, Dept. S-12, 2810 Portland Ave., Minneapolis, Minn.

MAKE $25.00 daily selling colored Raincoats and Slickers, Red, Blue, Green, Etc., $2.95. Hat Free. Commissions daily. Outfit FREE. Elliott Bradley, 241 Van Buren, Dept. AC-12, Chicago.

BANKRUPT and Rummage sales. $50.00 daily. We start you, furnishing everything. Distributors, Dept. 34, 429 W. Superior, Chicago.

POLMET—The Wonderful Polishing Cloth that cleans all metals without liquid, paste or powder. Approved by "Good Housekeeping" and "Modern Priscilla"—sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

SUCCEED With Your Own Products. Make them yourself. Formulas, Processes, Trade-Secrets. All lines. Catalog, circulars free. C. Thaxly Co., Washington, D. C.

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SELL Wonderful Hand Adding Machine. $1. Wholesale. Retail, $4.50. Typewriter Supply, 104 Hersch Bldg., Pittsburgh.

AGENTS make $100 week placing Cigar Lighters with glass advertising front. Free Plan. Drake Mfg. Co., Dept. P., Milwaukee, Wis.

TAKE orders for coffee, flour, dried fruits, canned goods, meat, staple groceries, toilet articles, paints, tires, auto and tractor oils. No capital or bond required. We deliver and collect. Permanent business. Big pay. Write at once. Hitchcock-Hill Co., Dept. 81, Chicago.

WE want Direct to Consumer salesmen or agents in every community for our Magnetic Trouble Lamp—Brite-Lite—the fastest selling auto necessity in the world—retails $3. BRITE-LITE sells itself on sight—agents make big money. National sales force now being organized. Here is a chance to join a live organization and have exclusive territory. Send details of your past experience and a BRITE-LITE will be mailed with full information. Address National Electric Corporation, P. O. Box 90, Dept. D., Newark, N. J.

SALESMEN to Sell Standardized Printed Forms to business houses. Good commission Hilliard—2663 Main St., Buffalo. N. Y.

Salesman and Agents Wanted

AGENTS, Demonstrators, Streetmen, Mail Order Men. After much effort we have secured the so called Self Shaving Cream formula. No soap or brush needed. Just rub on and wash off, and you have a clean shave. Think of the world wide sale of it. Every man a user. Women use it to remove superfluous Hair. Anyone can make it at home. No machinery needed. Be the first in your locality to supply the cream or sell the formula. Send only $1 bill for five other secret formulas, and get the Self-Shaving Cream Formula Free. Pikers keep away. No free particulars. The ad tells all. Mail a dollar bill and get the works. Modern Company, Dept. B, 540 E. 35th St., Chicago.

SALESMEN—Powerful Moneymaker. Electric advertising cigar lighter, flashing multicolor art movie ads. Sells easily. Make $255 weekly. Federal Mfg. Co., St. Paul, Minn.

AGENTS—We start you in business and help you succeed. No capital or experience needed. Spare or full time. You can earn $50-$100 weekly. Write Madison Company, 566 Broadway, New York.

AMAZING new invention. Abolishes rubber stamps! Sells every office. Big commissions. Write immediately. Manager, 59 Russ St., San Francisco, Calif.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly 250 Fourth Avenue, New York.

NOW Earn $15 a Day Easy. Take orders for shirts. Factory prices. Samples Free. Write quick. Fashion Wear Shirt Co., Dept. S-363, Cincinnati, O.

BE INDEPENDENT. Establish your own business. We furnish flavors, toilet preparations, etc., complete with your own labels. Lowest wholesale prices—less than your cost to manufacture. Edral Co., Dept. Y-15, Cincinnati, Ohio.

NEWEST Invention! Abolishes kinks and snarls. Automatically coils, telephone, electric iron and lamp cords. Housewives, companies actually buying 5 to 50. Tremendous profits. Samples furnished all salesmen. Neverknot, Dept. 12-F, 4503 Ravenswood, Chicago.

AGENTS—$12.80 Daily in Advance. Samples easily carried in Pocket. Every man a prospective customer. Complete outfit absolutely free. Cincinnati Shirt Company, Lane 16012, Cincinnati, Ohio

YOU Are Wanted To Resilver Mirrors at Home. Immense profits plating autoparts, tableware, etc. Write for information. Sprinkle, Plater., 96, Marion, Indiana.

OUR superior proposition will net you $100 a week, every week in the year. Equipment and car furnished. No capital or experience necessary. Immediate profits. Write today for particulars. American Products Co., 8943 Monmouth, Cincinnati, O.

SEND name, address on postcard. Free introductory copy Salesology Magazine; contains 1000 money making opportunities offered by big reliable firms; no obligation. Salesology Magazine, Desk B-229, 500 No. Dearborn, Chicago.

SALESMAN—Calling on the radio trade to sell Orthocone speakers—nationally famed for their wonderful tonal qualities. Low price, liberal discounts to dealers. Big commissions. An unusual moneymaking opportunity for you. Sample furnished. References required. Write immediately to Orthocone Speaker Co., 2728 St. George Court, Chicago, Ill.

GREAT neckwear line now free! Features finest quality neckwear at factory prices. Collect big commissions daily. Write for Free tie offer and Free outfit. Nawco Neckwear, Desk CZ-110, Covington, Ky.

RUMMAGE Sales (New Credit Plan) $50 daily profits. We start you. Headquarters, 1608 So. Halsted, Desk 21, Chicago.

WALKER made $165 first day selling Collection System to doctors and merchants. Retails $6.50. Collects $65.00 costs $1.50. Adjustment Assn., Mobile, Alabama.

AGENTS make $3.00 an hour taking orders for our 40 fascinating kitchen specialties. No competition. Write quick. General Products Co., Dept. M-231, Newark, N. J.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

"SUPERKEEN! Amazing new patented magnetic blade sharpener! Sharpens all razor blades instantly, magically, by powerful magnetic force! New! Absolutely different! Sensational demonstration! Whirlwind seller! Write for pocket sample!" SuperKeen, Dept. B-11, Salisbury, N. C.

ANY salesman can sell them! Merchants everywhere use punchboards. Someone sells them, why not you? Collect big commissions daily. Newest, largest elaborate catalog sent upon request. Lincoln Sales Co., 9 S. Clinton, Chicago, Dept. G.

START own business anywhere, without peddling or outfits. Free particulars. Elite, 38D, Elizabeth St., N. Y.

SEND 25 cents for a one dollar Cigar Lighter, and learn how to make $10 a day. Particulars free. Rapid Mfg. Co., 799 Broadway, New York City.

ANTIFREEZE prevents radiators freezing. Dricleen the combined auto cleaner, polisher. Radiator internal cleaner. Hand soap. Write for free shipment long profit auto specialties. Mickman Co., St. Paul, Minn.

AGENTS—$10 daily. New exceptionally useful 50¢ article for home and office. Pocket sample. Hydrawlk Corporation, Roselle, N. J.

CHECK protection experts make $120 weekly with ease. Free training now offered for this fascinating new profession. New checkwriter equals any machine on market at fraction of cost. Merchants, professional men, business men buy it at sight. Permanent, dignified position. Write quick for details and special offer. Arnold Checkwriter Co., Dept. W-40, Flint, Mich.

AMAZING new device. Sharpens knives, tools, scissors, automatically. Needed in every home. Also sells fast to Garages, Shops, etc. Agents making $3-$9 an hour. Everything furnished. Write for Free Outfit Offer. Central States Mfg. Co., Dept. W-1041, St. Louis, Mo.

AUCTION, Bankrupt, Rummage Sales, (New Credit Plan) Unbelievable Bargains. Enormous Profits everywhere. Original Headquarters, AP 1608 So. Halsted, Chicago.

Stamps and Coins

STAMPS, 100. All different, 3 cents. Lists free. P. S. Quaker Stamp Co., Toledo, Ohio.

STAMP Collectors—Phillips Monthly Bulletin (illustrated) offers over 2000 special bargains, sets, packets, etc. each issue. Free. Phillips, Box 1012, Hartford, Conn.

OLD coins, large Fall selling catalogue of coins for sale free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101B Tremont Street, Boston, Mass.

CALIFORNIA gold $¼ size, 27c.; $½ size, 53c. White coast and catalogue, 10c. Norman Schultz, Box 746, Salt Lake City, Utah.

150 GOOD mixed foreign stamps, 3c. Stanton (144), Kinsatic, Conn.

30 VARIETIES unused free. Postage 2c. P. S. Miami Stamp Co., Toledo, O.

100 GOOD mixed stamps, bargain lists, magazine, catalog, packet hinges, all 25c. Approvals for beginners. Harvey Teeple, Decatur, Indiana.

500 DIFFERENT 40c; 1000, 80c; 2000, $3.50. Fred Cohen, 630 79th Street, Brooklyn.

UNITED STATES and Foreign Coins. Military Decorations. Catalogue and 500,000 mark bill, 10 cents. Alexis Mengelle, Colorado Springs, Colorado.

1c, 2c, 3c, 4c, 5c and 10c approvals offered stamp collectors furnishing satisfactory references. Send for one and get three good stamps Free. Humboldt Stamp Co., Arcata, California.

FRENCH Colonies, 25 different, 5 cents. Big lists free. Challenge Stamp Company, 427 McDonough Street, Brooklyn, N. Y.

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Fine, imported instruments help you learn Drafting easily and quickly. These standard quality, full size instruments, including board, table, triangles, T-square, ink, protractor, etc. given without extra charge to students.

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The Welder—Tailor of Steel

(*Continued from page 33*)

to accurate dimensions, making them almost as good as new.

By similar methods, railway shops throughout the country are practicing large savings in equipment. Worn car wheels are built up by welding, lengthening their life as much as twenty percent. Worn rails are salvaged in the same manner. Rails with battered ends are repaired and reclaimed by welding without even removing the rails. Another recent development is the fabrication of welded steel railroad ties from worn pieces of metal track. Recent tests of such ties in railroad yards at Albany, N. Y., have indicated that they are ten times as strong as ordinary wooden ties and cost about one third as much.

IN THE automobile industry welding is proving invaluable in the manufacture of such parts as rear axle housings, torque tubes, bodies and frame members. Wire wheels for some automobiles are made by welding, and it has even been applied to the manufacture of spark plugs.

Even in the building of ships welded construction is proving feasible. Only a few weeks ago the first all-welded oil tanker was completed in a boiler works at Providence, R. I., and now it is operating successfully. The vessel weighs seventy tons, and its tanks have a capacity of 52,000 gallons.

Manufacture of tanks and containers of all kinds—furnace boilers, ice cream cans, refuse containers and the like—is being speeded by the welder's needle. For this work two kinds of welding seam are necessary—longitudinal and circular—and both are welded by automatic machines. The operator merely presses a button and the machine does the rest. The first arc-welded gas tank, with a capacity of 15,000 cubic feet, now supplies the town of Lexington, Mo. It was built in six weeks.

Many pipeline systems for water and gas recently have been made by welding. The first one to be completely welded, and the longest of its type, was constructed last year for the city of Vallejo, Calif. It is twenty-two miles long and carries water from one reservoir to another. The pipes carry a pressure as high as 173 pounds per square inch.

Two gas lines, extending for 300 miles from West Virginia into Ohio, are formed of twenty-inch welded steel pipe. A similar gas line, soon to be built, will extend 450 miles from the Texas Panhandle to Kansas City, Mo. It will carry 100 million cubic feet of natural gas daily at a maximum pressure of 450 pounds to the square inch.

SINCE the success of any welding operation depends largely on the skill of the operator, the General Electric Company recently has established a welding school in connection with its Schenectady shops. Here the company trains not only its own welders, but men from other manufacturing concerns who desire to become experts in the new science. Here students have turned out welded cabinets, lockers, refuse cans, stools, ladders, wheelbarrows, portable tables, carts, ash trucks and other equipment.

In the research laboratories scientists are constantly improving welding methods. Two new processes of producing more ductile welds recently were announced by two General Electric experimenters, working independently. In both processes, air is excluded from the metal by means of a bath of hydrogen or other gas. The formation of oxides and nitrides in the weld metal is thus prevented and the fused metal is declared to be as strong and ductile as the original metal.

These advances are opening still more fields for the application of metal stitching and are hastening the day when the nerve racking noise of the pounding riveter will vanish.

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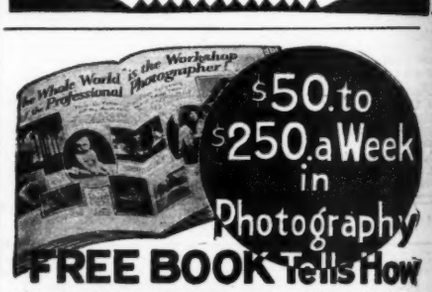

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Whirling Wheels

(Continued from page 42)

Perfectly legitimate—if he can get away with it. But—well, he hasn't hung himself quite enough for me yet, and until he does—" he shrugged.

"My boy, I apologize!" It was Oliver H. Marston. "I've done a little bluffing in my day, but that—that was masterful! Masterful!"

"It does kind of balance up the account on a T-head motor, doesn't it?" laughed Gil. "Now let's go ahead with business."

Then it was that Gil made certain promises. There was no doubt that the financial situation was dark. But, Gil maintained, that situation was only temporary. Automobiles had come to stay. Thousands of people owned them; there were automobile clubs everywhere, bonded together under the name of the Automobile Association of America, which was plugging for good roads and charting them, influencing the passage of sane laws, conducting runs. There were races and road events of all kinds, for professionals and amateurs. Glidden of Boston had inaugurated a yearly tour for amateurs, there were endurance and reliability runs galore. The public had the bug; a fact that was proved, if by nothing else, by all those mortgages. And they would continue to have it. So the thing to do was to weather this storm.

THERE was nothing to do but close the plant down completely. Men must be laid off who had never had an idle day since the new walls went up. "But we can meet a little pay roll with the money that Andy here is going to get in from the dealers, and with that we're going to get ready for some cutting of corners that have never been cut before.

"Do you realize what we've been doing?" continued Gil without expecting an answer. "I didn't until just a short time ago. Our selling price has been going up and up. Every year we've raised it instead of lowering it. Three thousand dollars this year—with top and windshield extra! The trouble with us has been that we haven't had to sell; people have bought. From now we're going to have to sell, more and more. Andy knows that, don't you Andy?"

"I sure do."

"So we've got to cut corners, more than we've ever cut before. How about it, Mac?"

"I'm hopin' so, Meester Herrick, but—" he looked doubtful, and Gil laughed.

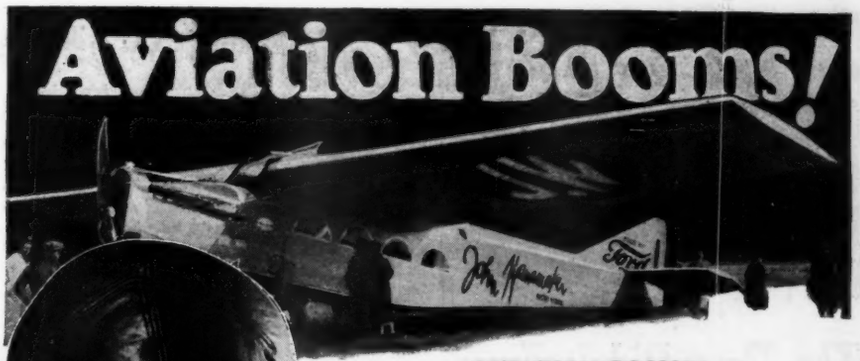
"Mac here thinks I'm crazy, but then you've thought so before, haven't you, old-timer? And you always go across with me. What we're going to do is take the progressive assembly idea into the machine shop; we're going to machine progressively."

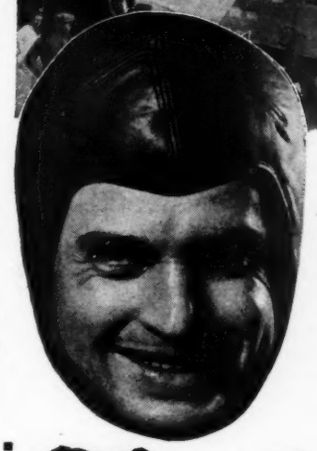
THAT was over their heads, so Gil explained. It was a case of starting the raw material—steel, cast iron, or whatnot, at one end of the shop and putting it through each successive machining process in order, so that when it was finished it would be "not more than two feet, maybe two inches, from the hand of the man who wants to put that unit on the car."

The thing that concerned Mac was that he would no longer be able to departmentalize his shop. There would be no lathe, no milling machine, no screw machine departments with responsible foremen. If it was necessary to put a lathe next to a screw machine, put it there; if a heating furnace had to be jammed up beside a milling machine, put it there; and when a man had done his job on the piece, he would drop it in a roller chute instead of a tote box, and it would roll by gravity to its next operation.

"No machine departments; parts departments, all of them. Well, suppose we had a map here that showed the rivers of the country. Trace one of (Continued on page 154)

Aviation Booms!





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Think what Aviation offers you. Thrills such as you never had before! The praise and plaudits of the multitude. And a chance to get in on the ground floor where rewards may be unlimited!

Aviation is growing so swiftly that one can hardly keep track of all the astonishing new developments. Air-mail routes have just been extended to form a vast aerial network over the entire U. S. Airlines and airplane factories are springing up all over the country. Men like Henry Ford are investing Millions in the future of commercial Aviation in America! The possibilities are so tremendous that they stagger imagination!

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Get into this thrilling business at once while the field is new and uncrowded. Now—by a unique new plan—you can quickly secure the preliminary training necessary to get a start in the Aviation Industry, either flying or ground work, at home during your spare time. Experts will teach you the secrets—give you the inside facts that are essential to your success. And, the study of Aviation by our method is almost as fascinating as the actual work itself. Every Lesson is chock-full of interest—and so absorbing that you actually forget you are studying. But best of all are the ultimate rewards you are fitting yourself to gain!

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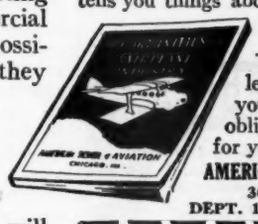

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"'Who's George Jackson?' he asked. Then he looked me up. Told me he was glad to see I was ambitious. Said he'd keep his eye on me.

"He did too. Gave me my chance when Frank Jordan was sent out on the road. I was promoted over older men who had been with the firm for years.

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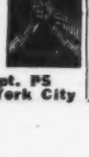

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Whirling Wheels

(*Continued from page 153*)

those rivers up to its source and then follow it down. First there's a spring, maybe; a little trickle of water. It flows along and other trickles join it until it becomes a brook, then a creek, then a river—and the river in our plant is the assembly line. Get it?"

They did, and approved. So that by the time the Vanderbilt Cup Race was run the next year, the Herrick Automobile Company had completely reorganized its machine shops and was on the way toward a record-breaking year—at a lower price. And this after a 1907 in which the production of cars failed to beat the year before for the first time in its history; only forty-five hundred jobs were produced instead of better than five thousand. And Gil was fighting another, different sort of battle.

"If you drive in that race, I'll leave you!" That was Gail's ultimatum, delivered with anxious, worried eyes. "I'm almost a widow now; I refuse to become a real one. If there were anything to be gained—but there isn't; you're just fighting Jim Wenden, that's all! And you might be killed! What about your three boys? Where will they be? Won't you ever think of us?"

THIS was backed up, moreover, by the equally strong protests of Oliver H. Marston, among others. "Asinine!" said he, fiercely. "Folly! Hire men if you want to; men who make racing their business. But don't risk your neck to please that braggart!"

"That's what I've been wanting to do," retorted Gil. "But you voted against it."

He was right. Practically every other manufacturer had a string of race drivers on his staff. A regular circuit of racing had been established and was growing. First they had driven on the thirty-mile strip of Ormond-Daytona Beach, that tide-swept expanse of Florida sand that was the finest, smoothest track in the whole world. Then circular tracks had been used, after which Vanderbilt, the same who had driven a race against time to Boston years before, offered a cup in the interests of speed and inaugurated road racing in the country. There must have been a half dozen such races run that year of 1908. They began with the First Annual Grand Prize, run at Savannah the spring before; they would end with the October Vanderbilt Cup, the crowning event of the year. And next year a new course was to be added: The Indianapolis Motor Speedway, two and one half miles of banked-curve race track. And through it all Gil had asked for racers. Racing develops engines, he maintained; it displays their weaknesses as nothing else does, and shows where they must be remedied. Only, to be denied. But this time Gil would race. And did.

IT WAS a magnificent course. Roughly triangular in shape, it included nine miles of the new concrete motor parkway that Vanderbilt's enthusiasm had created. Its curves were designed for high speed driving; there was not a single cross road. Gil covered those nine miles one day at practice in less than seven minutes, with Wally Burns yelling into the gale beside him. Then there was a turn north to the Jericho Turnpike, a dirt road with houses, telephone poles, and crossings on which they ran west to within a short distance of the start. After that there was a short run north on a twisted road to the corner that came just west of the grandstand. In all, the course measured 23.46 miles, with eleven of those laps to be made—258 miles of high speed!

On the morning of the race everything was in readiness. The Herrick pit was in the row near the grandstand, manned by expert mechanics and equipped with spare parts; magnetos, carburetors and a full assortment of dismountable tires, inflated on their rims. They were a great aid, those tires. The men had practiced until they could change one in less than four minutes. They also had two funnels, as big as washtubs; one for gas and one for oil, with nozzles so big that four five-gallon cans could be dumped through them at once. The handhole covers on the tanks of the car were fitted with easily gripped handles so that Wally could unscrew them before the car stopped rolling. They had a signal system all prepared, too, a method of reporting the car's position as it whizzed past. And the managers of the course had a completely equipped auxiliary repair shop over on the Turnpike, as well. Stalls were there, and tools of all kinds, and racers could scoot across the soft dirt before the shop and make any repairs that could not wait until the lap had been finished. There was one provision: only the driver and his mechanic could do the work. There must be no outside help.

SIX-THIRTY of a bright, clear morning. It had rained a little the night before and parts of the course were wet, but a tremendous crowd had driven through the night and was already packed in the grandstand and along the course when starter Wagner took up his duties. The racers were lined up in single file, Jim in number three position, Gil in number five, when a roar came from ahead.

"We're off!" yelled Wally through teeth that chattered with excitement, and Gil raced his motor a time or two to see that it fired evenly. Other engines roared, too, as one by one they shot away like projectiles, leaving clouds of billowing smoke behind them. "There goes Jim!" and the mechanics shoved their car along to the starting line. Then it was their turn, and Wagner, stop watch in hand, began his incantations.

"Ten—nine—eight—seven—six—five—four—three—two—go!"

A roar, clouds of smoke from the muzzles of the exhaust pipes that stuck out of the hood at the right, a quick change of gears, and they were gone. Gil settled down behind his wheel, his goggled eyes on the road ahead, Wally half sitting, half standing in his place at Gil's left. Pumping oil, looking forward, looking back. A white stream of concrete lined with streaks of white—fences—broken by black—the crowd. Rising, falling, curving beneath their wheels. Up the grade of one of the "roller-coasters." Its summit looked like the jumping-off place ahead of them, and suddenly fell away into a ribbon of road on the other side, every inch of it known to these two men. Jumping-off place—that is exactly what it was. They flew from the tops of those rises, fully sixty feet of flight before the wheels took the ground again. But they scarcely knew it, the trajectory was so level. All of that first nine miles was equivalent to flight, so smooth was that road.

AHEAD of them for a split second as they leaped from a high spot they could see a black speck in the center of white ribbon of road. Their leader. A long curve—it seemed only two breaths since they had started—and they were bouncing over the rougher Long Island dirt. Real shock absorbers—and chrome vanadium springs—let her bounce! Swoosh! a corner. Houses, telephone poles, the black and white of a crowd, dust in the air. Zip! swish! roar! The corner gone and wide open again on the backstretch.

"There's one down!"

Wally's yell, a backward flash of a motionless racer beside the road, with two figures bent over it. Already, before one lap was finished!

"Number four that was; Jim's ahead now!"

Ro-o-o-a-ar! Telephone poles looked like a picket fence. Another corner. Ease up on the throttle, take it wide, then cut her in. The now familiar oily (*Continued on page 156*)

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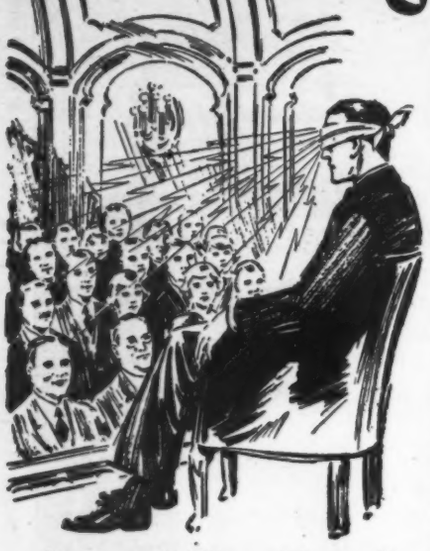

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Whirling Wheels

(*Continued from page 154*)

sensation of rear wheels skidding. The deft twitch of the wheel to catch that skid at just the right moment. Then down to the floor with the throttle again. More curves—always thicker with that black crowd than anywhere else—why?—and another sharp corner. The blurred bulk of a grandstand. So soon?

"Twenty-one!"

Wally had caught the flash from the pits. Good time, twenty-one minutes. But Gil could do better. Once more the swoops of the roller-coaster, again the black dot—far ahead. But in sight. First time Jim had appeared in sight. More white road, smooth as air; gray road, with dust hovering. Not many puddles. The corner—

"Brakes!" Gil yelled sidewise to Wally. "Loose!"

THEY had relined their brakes the day before. Maybe they had set them too tight; for now, after one lap, they would scarcely hold. Gil had had to take one hand from the wheel to seize the emergency—and return it to the wheel at once to stop that too-fast swing. Gosh! They missed that corner telegraph pole by a hair! But they missed it.

Wally on his belly, reaching through the floor while a surge of dust rose around his goggled head. Taking up the brakes. Good boy, Wally! Another corner. Brakes felt better. Curves, corner, grandstand. No yell from Wally this time. He was still on his belly. Easier now. Less bouncing. It was done; he was pumping oil. Whe-e-e! Up the first rise. Who-o-o! Down the other side. That black dot was the shape of a car now; they were closer. "Gas!" and Wally opened the auxiliary on the carburetor a little. They pulled up on the one ahead. Such speed! The long curve, the end of concrete ahead.

"It's Jim!"

He was lost in a cloud of dust—and they hurtled into it just behind. Plunged on, better than sixty, with only a few hundred feet of road visible ahead. Then a black something—that grew plainer. Jim was slacking a little for the rough road? No, the curve—and that corner. They hit it one after the other with less than two seconds between them.

"Get him!"

Down on the throttle again, with only one other thing in the whole world—that black, double-headed bulk ahead. One of those heads bent forward, the other showed white and black alternately as his goggled eyes looked back. "Get him!"

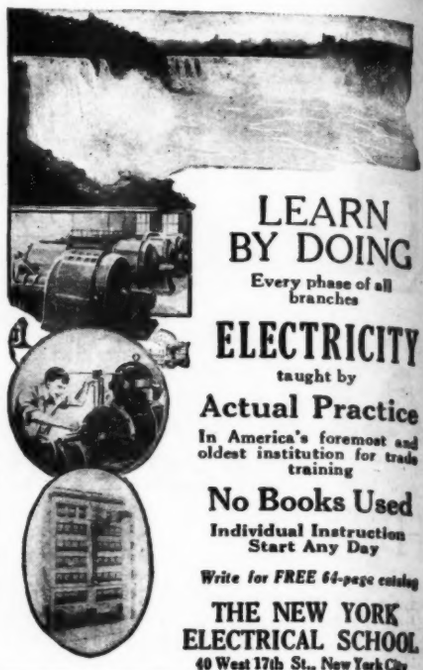
THERE is something a race driver acquires. Hours of driving do it, hours of sitting in a hurtling catapult that roars and bounces beneath him. It is a sense, very positive yet almost indefinable, of feeling that car and he are one and the same. "I would do thus and so," thinks the driver, and does it. With the car, automatically. He does not think: "I will pull my wheel so much, I will push my throttle so much and accomplish this and that;" he thinks "*I* will do this,"—and does it. In the same way that a pedestrian walking along the street turns aside and enters a door. He does not debate the turning; he does not send orders to his feet to turn, to his hands to open the door—he does it. So it was with Gil.

"Get him!" yelled Wally—and Gil "got" him. It was Gil who closed that gap, not a four-wheel projectile; it was Gil who raced along that dusty road. With Jim. It was Gil who saw the other man moving backward instead of holding his position in the corner of Gil's eye; who finally lost sight of him and saw only a clear road ahead; who threw on a little higher burst of speed—

"Got him!"

—and took the

(*Continued on page 157*)



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Whirling Wheels

(*Continued from page 156*)

center of the road again. And it was inside Gil that the cry of "Catch him!" now changed to "Keep ahead!"

Up to that moment there had been nobody behind him at all, as far as he was concerned; now there was nobody ahead. The thing inside had switched the tide of its flow. "Chase!" had changed to "Flee!" With Wally's eyes turned more often behind than ahead. Only one thing ahead now—those cattle that think it's smart to dash across the road. Supposed to be humans. The first thrill of the race over, inured to the roar and flash of hurtling monsters, the confounded fools wanted to play!

"He's dropping back!"

Swoop! Through curves. Swing wide, cut in, straight again. The wheels not wheels, but projections of Gil's thoughts, the brakes—they worked nicely now—his wish; the rear wheels that skidded were himself. Zip! Past the bulk of a grandstand.

"Pits! Gas 'n' oil!"

HAVE to stop the next lap. Lose precious seconds taking on fuel; maybe minutes, if one of those fabric tires was worn too thin. The only place where the machine entered in. All right, add up some minutes. Faster!

"He's out of sight!"

They seemed to crawl along that concrete ribbon. Up—as though they would go on into the heavens; down—a little heart-stopping drop. Up, down. Curve.

"He's two miles back!"

The long curve again. The sharp line where white concrete turns to brown dirt. Flashing trees, stone walls with black things on them. The corner, the Turnpike, the flashing telegraph poles—and a bewildered pedestrian!

"Get out of there!"

Standing, in the middle of the road! Crouching, as though to leap! Which way! Motionless! A twist of the wheel. Too sharp! You can't frolic with a catapult. A skid—and chaos! Crash! The world reeling. Crash! Over and over. Crash! Darkness.

"Where's Wally?"

The world still reeling, but Gil clawed himself to his feet. "Where's Wally?" Over there a battered thing that had been the catapult part of him. Men, running toward—a motionless bundle of something, crumpled. Wally! He ran. Someone was terribly hurt. He knew it; he could feel the pain. He charged through the crowd, knocking men aside. They staggered and stared. He flung himself down beside that bundle.

"Wally! Hurt, boy?"

THE tow-colored hair was red, the eyes, white where the goggles had been, were closed. He gathered it up in his arms. "Wally!" The eyelids lifted, and clear, bright eyes looked up at him.

"We got him!" whispered Wally.

"All right, Wally? Not hurt?"

"Me? . . . Naw . . . I'm . . .all. . . right."

He was lying; Gil knew it. He could feel the pain himself. He hugged those limp shoulders, and the reddening hair stirred against his breast.

"They're coming, boy. They'll fix you up. Hang on, Wally."

The dirt-smeared face looked up at him—and grinned!

"Sure!" Then he seemed to gather himself together and his eyes grew brighter. "Go get him, boss!"

He whispered it, and Gil's arms tightened on a something that was nothing.

"Good . . . God!" . . .

"What's he cryin' about?" some voice wondered.

"Aw, nothin'. Nerves, maybe. All shook up, poor devil."

(*Continued on page 158*)

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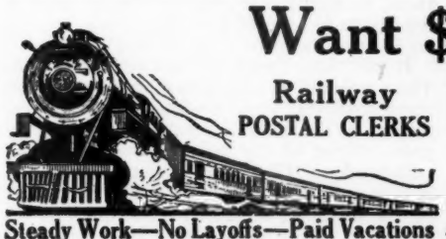

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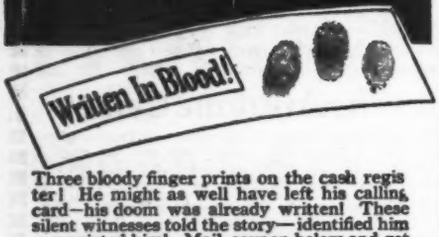

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Whirling Wheels

(Continued from page 157)

"But he saved that guy's life all right."

"And did you see him fly through the air? Like a rock with a rag around it."

"Here they come. Easy now . . . "

And blessed darkness swept down again. With the roar of another passing catapult resounding in his ears.

For The Game went on. Death? Disaster? They are only a part of The Game. Fools, they are called, the men who race; and not infrequently they are so named by the very ones who stand, addle-pated, in the middle of a road. But the God of Speed must be served, let Death stalk where it will. The Game went on.

Jim Wenden never passed him. So they told Gil at the hospital. A fan blade worked loose on Jim's motor and cut the radiator to pieces; the water leaked out and he had to stop or melt his motor. A Locomobile won that race. It covered the distance in four hours and forty-eight seconds, an average speed of sixty-four and thirty-eight hundredths miles an hour. Splendid time, with an American made car—Gil's head turned on his pillow.

"Are you taking care of—him?"

THEY had. Gil himself was not so badly hurt. Being under the wheel was what had probably saved him. He was thrown free at last—he recalled what a bystander had said—and escaped with some broken ribs and a collar bone smashed. That was all. He insisted upon being taken home, which they finally permitted, and was met by a Gail who wept.

"There, honey. I won't race any more."

"Thank God!"

"If I'd only listened!" Tears rose in his eyes. "I . . . "

She sobbed. "Oh, Gil. Poor Wally!"

"Bless your heart!"

Nor did Gil ever race again, except standing on a concrete floor—in a great room that he built after he had recovered, and dedicated to the memory of Wally Burns.

It was a huge place, that new experimental room. It adjoined the well-equipped laboratory where chemists and metallurgists were beginning to hold forth. For science was now finding a place in the manufacture of speed, and the uncharted course that he and other pioneers had been compelled to follow was slowly changing into charted ground.

THIS new room contained one of the first dynamometers, an electric affair with a panel board on which were electrical recording instruments of all sorts. It was supplemented with thermometers, pressure gages, tanks of metal and glass. As fast as a new instrument was devised it was installed, with a corps of men who kept steadily at work. It was the Herrick race course.

There it was that men began to devise a self-starter. The new distributor system was proved out there, replacing the magneto distributor. A dynamo arrangement was also put through there, though there were some who maintained that an automobile engine was not designed to run an electric lighting plant. Gil tested it, though, and thereafter all his crank cases had brackets cast integral with them, so that if a purchaser wanted electric headlights instead of Prestolite gas lamps, he could have them for a small extra charge.

It was there that Gil's first six was tested. Three pairs of cylinders cast *en bloc*, with a crank shaft that was drop-forged, then twisted so that its throws were separated by sixty degrees instead of one hundred and eighty, as with the four. They tested it on the dynamometer, found its horsepower on the brake and on the drawbar, measured its torque and its efficiency. Then they set it in a frame—a pressed steel one, with three-point suspension, and ran it over the (Continued on page 159)

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Whirling Wheels

(*Continued from page 158*)

roads, after which they tore it down again and measured its wear. It was so good that they announced two 1910 models, a four and a six, and the Wenden crowd was green-eyed.

But not for long, because in the middle of that year Jim Wenden announced the event that Gil had predicted: the formation of Motors Incorporated. With three models, a four and a six which were already in production on the plants he had taken over, and a new six which he was making in the Detroit plant. It had taken him several years to do it, and he had been treading on eggs by way of the stock market, but there it was.

"Some outfit!" was the way Gil commented on it to Oliver H. Marston, in whose private office he was sitting. "Look at what he's taken over. Three plants that were staggering, every one of them. All ready to drop, like rotten fruit."

"WELL, perhaps he's got the man to run them," suggested Mr. Marston. "Nothing like picking up a liability and turning it into an asset."

"It takes more than stock gambling ability to do that," said Gil. "All that man ever did was to play Wall Street and buy anything he thought he needed. Or bluff it out of somebody," with a laugh. "Which reminds me. I want to borrow some money on a personal note."

Mr. Marston's eyes narrowed speculatively. "To do the same?" he asked. "That's one thing I never could accuse you of, my boy; don't do it."

"I won't—yet," said Gil with a grin. "And anything I do will be talked over with you first, Mr. Marston. What I'm after now is control of the Herrick Automobile Company. I can't play with fire until I get some insurance. Maybe the next time I won't be able to bluff Jim Wenden. I'm going to own more than half of the stock."

"H-m-m! Very laudable ambition. But it will cost you some money. Know how much?"

"Yes. I need two hundred shares. That means a million." He said it as coolly as though he had forgotten the time, some years ago, when he had driven three times around a race track to earn the right to borrow ten thousand. "I've got about half of it, so if you'll let me have the other half—and I've got the options all signed, too. Most of them in Wendenville. They took a look at the cash they could get back on a hundred dollar investment, and fell."

"What is your security?"

"Three hundred shares—which I couldn't sell because no one would buy," with a chuckle.

MR. MARSTON joined him in that, and pulled out a drawer of his desk, from which he took a pad of blank notes and filled one in. "Sign it," he said, and shoved it across the plate glass. "You won't need an endorser; not with that security." He might have added that he would endorse it himself if necessary, but held that back; it doesn't do to say too much.

"I don't have to tell you that old Zach isn't selling," said Gil as he blotted his signature, and Mr. Marston chuckled again.

He had met old Zach Wenden several times. That huge man—he was still sizeable, though his advancing years had bent him a trifle and his beard was white—had come to see Gil, who had taken him to call on the banker.

"Mr. Marston, here is the first friend I ever had." That was the way Gil had said it; the old gentleman remembered it well. With a little accent on the "first." "He made my life worth living in Wendenville, in spite of that no 'count son of his."

Then big Zach's (*Continued on page 160*)

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Whirling Wheels

(*Continued from page 159*)

voice had rumbled a good-humored refutation of it; his shrewd black eyes had twinkled. "Oh, I don't know. Reckon maybe my boy Jim's got his uses. How 'bout it, Mr. Marston?"

And the banker had agreed. "Maybe so; maybe so," and shaken Zach's hand with an understanding grip.

They had understood one another from the first, those two. They were still playing the game of living, but not quite so intensely, and had time to observe. The banker remembered distinctly how Gil had laughed tolerantly at their remarks. Well, Gil might not laugh with that accent later on; he might discover what they meant. But he would have to do so himself. There are some things men won't believe, even when told them by their best friends. Look what Gil was doing now—and his attention came back to the present.

"No, sir," Gil was saying. "I wouldn't let old Zach sell; not if he wanted to." Then, with a warm light in his eyes, he added—"or you either," after which he shook hands quickly and bustled out of the office.

Jim Wenden's crafty scheme to "get" Gil has been balked. He has been passed on the speedway—and at what a price! Will he be made to pay, at last, for the years of bullying, trickery, and insult which he has heaped upon Gil in vain efforts to gain the mastery? There's a big surprise in store for you in the final installment, in next month's issue.

"I'm Going to Send My Boy to College"

(*Continued from page 56*)

total. But from this college-bred minority of nine in a thousand industry draws somewhere between *one fifth* and *one half* of the fellows who are bossing the other 33,000,000!

And I'm planning to send my boy to college because I want him to be the one in a hundred who gets the best breaks in business life.

I admit there's something to the argument that even without a college training, the boy with real ability can make progress. But I can't overlook the great numbers of opinions from business leaders who say that the college-trained man makes better speed—and that he makes it *because* of his college training.

Take just one such opinion, parallel to many which I have heard. It comes from J. C. Penney, who owns 885 department stores in forty-six states. Of the college men coming into this huge business of his, Mr. Penney declares:

"Those men are going to the top sooner or later and, *because of their superior mental training*, they are going to rise more rapidly than the men of average education."

NOW, whether or not college education is actually as important as all this, remember that big business men *consider* it to be this important. And since they feel that way, they're going to hand out their good jobs to college men.

When I go fishing, I go where the fishing is good, and I use the sort of bait that fish are taking. And it's plain, from this universal attitude of big business men, that the best fishing for jobs, today, can be done from the commencement platform with a college diploma for bait.

The big corporations everywhere are combing the college crop each spring for future executive material. Some of them have personnel officials whose whole duty is to select and train each new batch of college-bred employees. (*Continued on page 161*)

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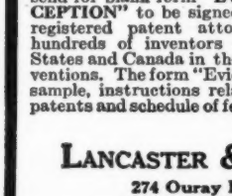

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"I'm Going to Send My Boy to College"

(*Continued from page 160*)

To Yale graduates in 1925 there were offered through the Yale Bureau of Appointments 500 jobs in 183 companies. They tell me many other colleges have similar employment bureaus through which the graduates may get a fine start.

Besides that, the boy who goes to college makes a great number of friends from all parts of the country. Through them his eyes are opened to many fields of opportunity that the mechanic, in his limited little circle, never knows about. I know of one boy who graduated from a small college last June and to whom seven jobs, each with a promising future, have been offered through his friends in previous classes. One of these jobs was in Cincinnati, one in Cleveland, two in Chicago, one in South America and two in New York.

THAT shows how, just through his college friends alone, the university graduate's job-hunting horizon is widened. And everybody is pulling for him. The big corporations come seeking him; his college placement bureau, his alumni association, his professors—yes, and the fathers of the girls he meets at college social affairs—all these are only a few of the possible helpers in getting him started.

And on top of that, the colleges are developing vocational guidance experts who give the undergraduates valuable assistance in finding out what they're best fitted for in life, and then in picking the courses that will train them for this vocation.

Finally, while the noncollege men in executive positions think highly, as I've shown, of the university graduates, the executives who themselves are college graduates tend to pick their assistants almost exclusively from the colleges. Maybe that's snobbery, and maybe it's sound business judgment. Anyhow, it's a practical fact.

Now admittedly, with every year, a greater proportion of college graduates are getting the two million administrative jobs in American business. Hence with every year there will be a corresponding increase in the demand for other college men to become their assistants and start up the ladder they have climbed.

Compare all this wealth of future opportunity for the college man with the limited opportunities ahead of the high school boy who wants to become a skilled mechanic.

There are probably about a million boys of high school age who must go to work each year. And there are only about 175,000 apprenticeships open to them in the highly paid trades.

ON the other hand, according to the National Industrial Conference Board's figures, there should be about 40,000 entirely *new* places open annually in the administrative field for which a college education is known to be the best preparation. About 40,000 new openings for men of executive caliber—wholly aside from annual replacements! And the engineering colleges—which in my opinion give the best technical training for such positions—graduate only about ten thousand men a year.

So there are, roughly, four of the better jobs for each technically trained college graduate; but there's only one apprenticeship in the highly paid trades for every six boys of high school age who go annually to work.

That's why I want my boy to go to college, and it's also why I want him to take an engineering course. But even if he takes a general academic course, and so becomes one among approximately 80,000 annual graduates, instead of one among 10,000 engineering graduates—why even then he'll be one among the privileged few. The personnel director of a great corporation in New York, who has devoted years to this

(*Continued on page 162*)

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"I'm Going to Send My Boy to College"

(Continued from page 161)

very subject, declares that American industry can absorb more college men annually than the colleges are turning out now, or than they will be turning out for a long time to come even with the rapidly increasing enrollment.

But look once more at the skilled trades. Even after our one-boy-in-six has succeeded in becoming an apprentice, he's likely to have a hard job getting work at his chosen trade.

For instance, in New York City, in the building trades, they say that apprentices have been going back to jobs as office boys, errand boys and shipping clerks—because the building contractors don't give them work. A recent survey of conditions among the bricklayers in fifty-eight cities showed that there was room, even under the union restrictions, for 10,000 more apprentices than the contractors were employing. In 1925, in Boston, thirty-five to forty percent of apprentices enrolled during the preceding year in the building trades were unemployed.

SO WHEN I think of my own boy's future it's pretty clear to me, both from the statistics and from my own experience, that he'll have the odds heavily against him if he tries to follow in my footsteps, but that if he goes to college the odds will be all in his favor.

Besides, I object to the merely financial arguments, to which Mr. Payne confined this discussion as so many others do. After all, there's more to life than just earning money. For instance, there's the amount of pleasure you can get out of your work, and the amount of pleasure you can get out of your leisure time.

Now I think that only the educated man knows how to get the finer pleasures out of his leisure time; and I know that only the educated men can get pleasure out of his work—because it's brain work, not mechanical routine.

A mechanic is only a machine. He may be as simple a machine as a hammer is simple. All a skilled lather has to do for his possible $16 a day is to cut bundles, hold a mouthful of nails and pound away deftly. Or, in some trades, a mechanic may be a rather complicated machine, as a locomotive is complicated. But it took brains to design the locomotive and it takes somebody's brains to run the mechanic.

True enough, his job requires intelligence and good habits of workmanship. But it doesn't require real brain work. And that's why his job is irksome—because any form of mental effort is more pleasurable than the routine drudgery of wrestling with a stock-and-die or slapping on mortar with a trowel.

It all simmers down then to two facts: Good money is paid for brains and not brawn; and the real pleasures of life are mental and not physical. The old recipe for success is to get pleasure out of your work. If that's correct, don't be a mechanic. Go in for brain work.

BUT brain work isn't possible unless a fellow's brains are *cultivated*. And the boy who gets caught up in manual labor may never even discover that he's got brains to cultivate. The human mind isn't equipped with a self-starter. It takes education to start a boy's brains to working inside him.

So, take a plumber's word for it: Anybody who sets out to raise his boy to be a plumber is going to let that boy in for a sad awakening.

But the plumber's boy, if he has any brains at all, only needs to have them cultivated in order to get a whole lot more out of life than his dad was able to.

And unless all the statistics are wrong, unless all the opinions of big business men are wrong—unless seven hundred years of history since the founding of the first great universities are wrong—then the college is the place to cultivate brains both for success in business and for enjoyment of life.

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Why Building Plans Go Awry

(*Continued from page 68*)

with a high-class clientele, whose fee is ten percent of the cost of a building, do not usually charge anything for redrawing a design. But the cost of changing actual construction must, of course, be borne by the client. Such changes happen often enough. There was the case of a woman who ordered casement windows. Casement frames were placed in the walls. Then she vetoed casements for a room on the exposed side because they might let in rain. It is rather difficult, in fact, to make such windows storm-tight. She got narrow side-weighted windows, equipped with lead weights instead of the usual cast iron so as to fit in the space. The alteration for a few windows cost $160."

WHETHER an architect should seek to guide his client into a straight and narrow path of artistic economy or should cater to his penchant for vacillation and revision is a question that has been frequently discussed. Some think an architect should, like a doctor, prescribe what is best for the patient—that is, client—and see that he takes his medicine. Others hold that such a course is impractical and futile. People believe in doctors but they have slight faith in architects, and resent too much guidance in respect to the style and layout of their homes. The result of this widespread attitude is that not a few architects proclaim their platform is to give the public what it wants.

Among those who believe an architect owes more to his client than ready acquiescence in every flighty notion is R. A. Gallimore, who is associated with Frank J. Forster in the planning of distinctive homes. People can be reasoned with in a diplomatic manner, Mr. Gallimore told me. They can be made to understand a design by explanation and model, and they can be persuaded to stick to it instead of losing themselves in a morass of indecision, botching alteration and unwelcome expense.

The evils of plan changing have been lately campaigned against by The Architects' Small House Service Bureau, a national organization of public-spirited architects endorsed by the United States Department of Commerce. Plans are sold for an average price around $30 a set, and houses are built from them by local contractors in various parts of the country, usually without supervision of an architect. Buyers think up changes, local builders offer suggestions, friends and relatives are liberal with advice on alteration. In consequence the house may be spoiled in looks, in construction or in both. It is certainly unsafe for the rank amateur to meddle with a carefully thought-out design.

IF CHANGES are desired submit them to an architect and have them clearly indicated in the working plans. A proof of a builder's incompetence as an architect is his vague sketch or his pallid apology for a blueprint which is not in scale and shows undecipherable figures. Such a plan may be a masterpiece, but the chances are a thousand to one that it is but the fuzzy reflection of the builder's confused and rule-of-thumb mentality. The average owner, to whom a real plan is enough of a Chinese puzzle, must be totally obfuscated by such output, yet—perhaps because of that fact—he seems impressed and takes a chance.

Some few regular architects can be fairly criticized for their exaltation of art at the expense of practicality. For example, some design a frame house to sit squatly on the ground. Every practical builder knows a high foundation protects against dampness, decay, insects like white ants, and fire in leaves or rubbish alongside the house. With a low foundation the price of beauty is too high. Use and looks should be harmonized.

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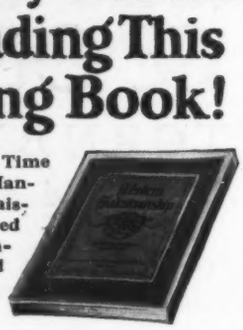

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Here Are Correct Answers to Questions on Page 46

1. Because of the common phrase "beer and skittles," many people imagine skittles are something to eat or drink. Skittles is, in fact, a game much like bowling, played in the Netherlands.

2. The Amazon basin in South America, which covers more than two million square miles. The population is less than one person to the square mile. The reason is too much fertility. The country is covered with an almost impassable jungle of natural vegetation.

3. The island of Porto Rico resembles other islands in the West Indies in being very well watered on one side and not well provided with rainfall on the other. This is due to the direction of the prevailing winds. Extensive districts have been placed under irrigation.

4. The famous Magdalena Bay, on the west coast of the southern part of the peninsula of Lower California, although an excellent harbor, has no supply of fresh water. Lower California is one of the most nearly waterless countries of the world.

5. Although the Alaskan winter is cold and long, the summer is warm enough for the growth of many useful plants.

6. The great iron ore region is in Michigan and Minnesota, bordering on Lake Superior.

7. Two depressions in California possess this distinction. Death Valley is one. At the bottom is a small lake of brine nearly 300 feet below sea level. It is the lowest point in the United States. Farther south is the basin occupied by the Salton Sea. This, too, is below sea level.

8. An imaginary line drawn north and south across the Pacific Ocean to mark the point at which the marine day changes. Ships at sea are accustomed to take the ship's time from the sun. Accordingly, if a ship traveled clear around the earth, it would either gain or lose one day. Without some agreement as to which day was which, the ship's captain would never know. The International Date Line determines this. In the middle part of the Pacific the line coincides with the 180th meridian west of Greenwich. Eastward of the line is the earlier day. For example, it is Sunday east of the line when it is Monday west of it.

9. Such ornaments are greatly prized among the negro natives of Kenya Colony in the eastern part of Central Africa.

10. This is the famous Suez Canal. It crosses the isthmus connecting Asia and Africa and allows ships to pass from the Mediterranean to the Red Sea. The Suez Canal is ninety miles long, nearly forty miles longer than the Panama Canal.

11. The most numerous people in the world are the Chinese, there being at least 400,000,000, possibly as many as 500,000,000. Nearly all Chinese speak languages belonging to the same general group. However, there are many dialects.

12. The famous 1,200-mile Chinese Wall, in China, was built more than 500 years ago to keep out barbarians from the north.

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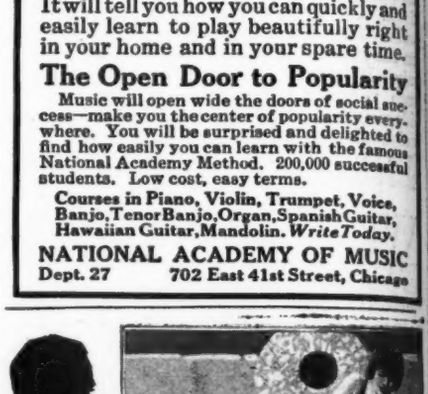

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The Human Mind Craves Wonders

(Continued from page 24)

restoring strength, relieving rheumatism, backache, kidney, liver and bladder trouble and whatnot.

From time to time dozens of these or similar devices have been advertised and sold widely in this country. There has been, for example, Addison's galvanic electric belt that can be purchased for $1 per dozen, but which retails for $2.50 each. There is the electric chemical ring supposed to cure diseases caused by acid in the blood. When its promoter was brought before the postal authorities, he volunteered the information that his receipts for one year were $45,600 and that it took fourteen people to help him supply the demand for his device. The Owens electric belt is supposed to knock rheumatism and stomach trouble, while the Sanden electric belt will cure, it is claimed, almost anything. Practically all of the electric belt concerns have been subject to fraud orders issued by the Government, denying them the use of the mails. But the group of persons ready to be mystified by electricity is perennial.

IN THE period between 1910 and 1916 thousands of persons fell for the gas pipe cure. A dozen devices were put on the market consisting of a piece of nickel-plated pipe closed at both ends and filled with some dust or chemical substance of little or no value either physically or monetarily. To this piping were attached one or two flexible wires, at the free ends of which were small disks with elastic bands or buckles so that they could be fastened to the wrists or ankles of the user. This cylinder would be put into cold water and the patient would lie patiently while he was presumably receiving some sort of force, characterized by the inventor of the first of these devices, one Hercules Sanche, as "diaduction." The first device was called an "electropoise," again conjuring with the magical word "electricity."

Later examples were the oxydonor, the oxypathor, the oxygenor and the oxybon. The Government issued fraud orders against all of them. The price paid by some of the victims varied from $5 to $35 for the little apparatus that cost about $1.23 to manufacture. The claim of "cure-all" is sufficient always to attract the unwary.

CONTRAPTIONS such as these are sold with preposterous claims as to their efficiency. Nevertheless, the magic that lies in some of the modern medical discoveries actually is far more marvelous. Consider the recent discoveries relative to light. For years mankind has suffered with the disease known as rickets, in which the long bones of the body become soft and do not grow satisfactorily. Thousands of children have been bow-legged, have had little pot-bellies and flat chests with beaded ribs, because of this disease. When Doctor Huldschinsky first suggested that light might aid in preventing this disease, his views were greeted with rather calm disdain. But with the passage of time the work of Dr. Alfred Hess, of Dr. Steenbock and of many others has shown that regular exposure to ultra-violet rays will prevent the disease, and will even stimulate the body to bring about a cure if the disease is caught in its early stages.

The phenomenon is wonderful and it has been demonstrated on animals as well as on man. Here is the difference between the unsupported claims of Abrams and the brilliant scientific demonstrations made by qualified research investigators.

One of the significant facts brought out by research in the present century has been the marvelous effects of insignificant doses of certain substances. The human body is sometimes sensitive to ex- (Continued on page 166)

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The Human Mind Craves Wonders

(*Continued from page 165*)

ceedingly small doses of proteins or indeed of some inorganic chemicals; for instance, in hay fever and asthma the symptoms are the result of a special sensitivity to some protein. The body is so sensitive that the protein substances mentioned may be diluted down to a millionth part, and one drop of this placed in the eye of a sensitive person will produce an inflammation.

In the prevention of goiter, iodin is given in doses of one tenth of a grain once a week for ten weeks to children.

The anaphylactic reactions, or the response of the body to a protein when it is sensitive, is so powerful that an animal may be killed as though by a stroke of lightning if it is first sensitized to a protein and then injected with a tiny dose of the protein substance. It is hardly surprising that people will believe anything in the field of quackery in the presence of knowledge of the phenomena that have been described without any accurate comprehension of the mechanism.

THE American public is most afflicted of all nations in the world by peculiar systems of healing and by fraudulent cures for all sorts of diseases. The index file of quackery in the records of the American Medical Association contains more than 125,000 cards representing various forms of quackery that have preyed on American credulity.

The cures for cancer, for tuberculosis, for the other ills of mankind are legion, and new cures constantly appear. There are at least thirty-seven cults of religious healing, to all of which the magical word "science" is somehow attached. There are manipulative cults, faith-healing cults, electric cults, mechanical cults, nature healing cults, dietary systems, and hot air treatments, if all of those that precede cannot be accredited to the one named last. Practically all of the records of recovery credited to any of these fraudulent systems or devices may be classified as faith healing, curing the victim of a disease that he does not have, or acting as a sort of soothing syrup while the natural healing powers of Nature—the tendency of living tissue to get well—carries the afflicted one to recovery.

Physicians have long given thought to the means by which human beings might be disabused of their credulity and brought to a realization of what constitutes fact in medicine. Apparently the only hope is in education of the public so that people will be just as interested in reading about the human body, the manner in which it is built and its functions as they are about airplanes, motor cars and radios.

BUT there will always be those who enjoy the spectacle of a miracle. Perhaps people suffering from mental disorders, who are not actually sick but only think themselves so, will continue to seek shrines, faith healers, psychoanalysts, and various forms of religious healing. But the man with a knowledge of bacteria and the way in which they cause disease, who knows the futility of conjuring methods, who knows enough about electricity, physiology and physics to see the fallacy of the claims of an Abrams or a Wilshire, is not going to spend his money in fraud when scientific medicine has something certain to offer.

There are enough wonders in science itself: in the mysterious powers of the glands of internal secretion, in the magnificent regulating system that controls the temperature of the body, the heartbeat and the respiration; in the human eye, the most marvelous photographic device ever invented; in the brain, which sends impulses to other portions of the system that lead to action. These wonders, once understood, are far more miraculous than any of the things purveyed by the miracle monger—and they sell for less.

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Myths About Mars Exploded

(*Continued from page 16*)

the surface of Mars under a noonday sun surpasses the melting point of water. During the Martian night, however, the temperature evidently falls to sixty degrees below zero, or lower, and it is probable that the equator is not so warm during the summer as the particular pole which is turned toward the sun at the time, and which is experiencing the phenomenon we call the "midnight sun."

Astronomers now agree that Mars has water, though in no large amount; that it possesses a meager atmosphere, and a temperature which at least permits the existence of liquid water upon the surface for a part of the day. These facts, coupled with the observed changes of the dark areas as the seasons come and go, strongly support the theory that vegetation is responsible for the markings.

IT IS probable that most, if not all, of the oxygen in our atmosphere is the product of vegetation. If all plant life on earth were to be destroyed today it would only be a short time, geologically speaking, until oxygen, extremely active chemically, would disappear entirely as a part of the atmosphere, having combined with the earth's crust. The presence of oxygen, therefore, in the atmosphere of Mars may be taken as certain evidence that vegetation now exists, or has recently existed, there. The former view is probably the correct one. Venus evidences neither water nor oxygen, making any there highly improbable.

Martian vegetation may resemble the tundra moss of the great plain of Siberia, for this hardiest of plants would possibly be best fitted to cope with the low temperatures of the Martian night. The more imaginative will certainly argue, "Where vegetation exists, animal life, possibly intelligent, may also exist." Granted, but I would place great emphasis on the word, "*possibly*." It is a long jump from Moss to mushrooms, from mushrooms to monkeys, and from these to man.

The chance that we may some day communicate with Mars appeals to most people. Let us calculate the chance which an observer beyond our earth would have had in establishing communication with us. Geologists tell us that the earth is at least a billion years old. Man has not existed more than a million years, or one one thousandth of the earth's age. The distant observer's chance, therefore, of finding anyone at home here would be only one in a thousand. Since civilization is certainly not older than 10,000 years, his chance of finding *intelligent* life decreases to one in 100,000. Finally, if radio is to be the ultimate means of communication, our observer's chance of getting some one on the line is much less than one to fifty million!

BUT, "why should the earth be especially favored with life intelligent above that of all other planets?" I hear some person argue. To which I reply: "Of all the planets, the earth is so situated that liquid water is present in large quantities throughout the year. An abundant atmosphere and uniform temperature are additional incentives to life and, while I cannot disprove the existence of Martian animal life, I regard the presence of its higher forms as an improbability."

Astronomical research has shown you a planet very unlike our own, to be sure; but why should it be like the earth? It is reasonable to expect Nature to give us infinite variation. Many will be disappointed, no doubt, that I cannot find evidence for intelligent life on Mars, or recommend the planet to them for a summer home. These will ask, "But can you not conceive of life in any other form?" I can only answer, "Your imagination is as good as mine."

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HERE'S an absolutely new, money-making proposition that will bring you big profits—*easy profits*—QUICK PROFITS! You can make $50 a week in spare time—$100 in full time—taking orders for JIFFY GLASS CLEANER—a new, pure, harmless liquid that easily and instantly cleans glass surfaces without water, soap or chamois. Think of it! Unequaled for cleaning windows, mirrors, windshields, show cases, eyeglasses, etc.

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I don't want you to send me a cent. All I want you to do is let me show you how you can make $50 to $100 a week, without experience and without taking any course of training. I agree to furnish everything you need, to tell you what to do and say in this easy, fascinating work. You positively take no risk whatever. You can't lose a penny and yet you have a wonderful chance to reap big profits quickly. You can make $10 to $20 a day right from the start.

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$351.00 CLEARED IN ONE DAY

So writes W. H. Adams of Ohio. Letter from V. A. Marini of California reports $11275 sales in three months. Jacob Gordon of New Jersey "$4000 profits in 2 months." Alexander of Penna. "$3000 profits in four months." Ira Shook $365 sales in one day. Bram bought one outfit April 5 and 7 more by August 28. Iwata, bought one outfit and 10 more within a year. Mrs. Lane of Pennsylvania says "sold 8000 packages in one day." J. R. Bert says "only thing I ever bought that equaled advertisement." John Culp says: "Everything going lovely. Crispette wrappers scattered all over town. It's good old world after all." Kellog, $700 ahead end of second week.

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C. K. Morris, Chicago, got rid of a bad cold just overnight. Frank L. Wood, Petersburg, Mich., says, it has relieved him of lumbago, catarrh and inflamed eyes.

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You will recall that I took a Correspondence Course in your school and was placed in a position a year ago.

I am not going to try to say what the School and the Employment Department has done for me, but it is so much beyond my expectation that it would sound to a reader of this letter beyond reason, but I was placed in a position at $110 per month, was raised to $135 at the expiration of one month, and am now getting $150 per month and like the work fine.

I find the men who are my superiors to be pleasant generally to meet and to work for, and they are invariably favorably impressed with your school.

I am indeed grateful to you and your Institution. You have been a stepping stone to my future and I cannot thank you sufficiently. I wish I could tell some of the under-paid who are dragging along in a tough rut about your Institution.

Again let me thank you.

(Signed) Ed. Grogan

Our students never worry about a position as one will be offered them within a few days after completing the Traffic Inspection course. You start at $120 or more per month plus expenses. Our contract shows why you take no risk.

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STANDARD BUSINESS TRAINING INSTITUTE
Division 3 Buffalo, New York

Getting Ready for the Next War

(*Continued from page 27*)

his book, "Statesmen and Soldiers of the Civil War."

This year the American Army has devoted special attention to experiments with aircraft. At San Antonio, Texas, maneuvers, Secretary Davis and Assistant Secretary Davison, Major General Mason M. Patrick, head of the Air Service, and Brigadier General James E. Fechet, second in command, were present with Major General Amos A. Fries, chief of the Chemical Warfare Service, and Major General Malin Craig, Chief of Cavalry.

To Major General Ernest Hinds, Commanding the Eighth Corps Area, and to Major General W. D. Connor, commanding the famous Second Division, was entrusted the task of devising methods for all departments of the Army to work together. At the end it was concluded that the Army Air Corps had proved its value as a reliable offensive, defensive and reconnaissance instrument.

THE American Army has formulated rather a conservative view of air power in the next war, but Rear Admiral Colby M. Chester, now retired, first naval officer to fly, has said:

"The Lindbergh flight makes fiction of the proverbial 3,000 miles of the Atlantic between the United States and Europe. The United States is no longer invulnerable, because the distance factor has disappeared."

New types of fighting airplanes are being constantly developed, such as the new Curtiss armored biplane that had its test flights at Mitchel Field, N. Y., in July. The *Condor*, as she is called, has six machine guns and tons of bombs.

The British claim the largest bombing airplane, weighing ten tons, carrying bombs and a ton-torpedo. This is a more powerful plane than our new Duff-Daland bomber called the *Cyclops*.

Secretary of the Navy Wilbur recently approved plans by the Goodyear Tire and Rubber Company for the world's largest dirigible, of 6,500,000 cubic feet gas capacity, capable of carrying gun batteries and five airplanes to defend it from fighting planes. The British recently launched two battle planes from their airship *R-33* at a height of 2,000 feet.

The most striking note in the controversy over the value of aircraft in war was struck by a mysterious unknown Englishman writing under the name of "Neon," who quotes Major General John L. Hines:

"Aircraft will always be limited as to their radius of action. They will always be dependent on favorable weather conditions. They will always require land or sea forces for the protection of their bases."

Not long ago, an American general said anti-aircraft guns would defeat raids.

"FOR they would not be such antiaircraft guns as were used during the war," he said, "although those were more accurate than anyone gave them credit for being. Five American 'archie' batteries brought down seventeen planes with 10,275 rounds. Two American antiaircraft machine gun battalions brought down, in a little over two months, forty-one airplanes.

"But antiaircraft has improved since then. Do you know that now, antiaircraft guns are more accurate than field guns? They now make 9.15 percent of hits per hundred shots, and the Field Artillery, firing on targets on the ground, troops, trenches, etc., makes six percent."

Progress made in antiaircraft was recently described as follows in *Army Ordnance* by Major C. G. Mettler, Ordnance Corps, U. S. A.:

"They have developed better listening devices to indicate the approach of the hostile airplane, to determine (*Continued on page 169*)

DRAWING IS A WAY TO FORTUNE

All Hafed, a Persian farmer, sold his acres to go out and seek his fortune. He who bought the farm found it contained a diamond mine which made him fabulously rich. All Hafed overlooked the great opportunity at his door to go far afield in search of wealth—which illustrates a great truth.

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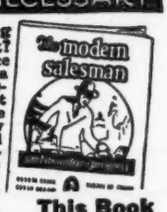

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Getting Ready for the Next War

(*Continued from page 168*)

the altitude at which he is flying, to make more accurate corrections for wind, atmosphere and powder. They have learned visually to measure the rate of the airplane, both horizontally and vertically, and to plot where he will be when the projectile reaches that vicinity."

A new antiaircraft machine gun has several barrels operated by a single control that literally spray bullets upon aircraft as high as 12,000 feet. Our new four-inch antiaircraft gun can reach 40,000 feet straight into the air.

INTERESTING tests will be possible when the new thirty-seven-millimeter antiaircraft gun is fully developed. This is the familiar "toy cannon" that the doughboys used to drag with them to fire against machine gun nests. As an antiaircraft gun it will fire one-and-one-fourth-pound projectiles 100 shots a minute.

General Pershing has called unlimited development of gas "shocking to the senses," but a German manual called *Der Chemische Krieg* says gas is "a vital weapon" which will "confer world importance or even world power on the nation which shows supreme capacity in the field."

Dr. Charles L. Parsons, secretary of the American Chemical Society, said recently that when technical experts of the United States, Great Britain, France, Italy and Japan met to study the poison gas situation all had secrets to conceal.

So many are the new developments in artillery, machine guns and rifles that the losses in the next great battle will be several times as heavy as those in, for instance, the Meuse-Argonne, the greatest American battle, where we had 125,000 casualties in forty-seven days.

American ordnance experts have increased, sometimes tripled, the ranges of cannon, machine guns and rifles, due largely to the development of a new shape for shells and bullets—the streamline base, or boat tail.

The point of the projectile has been sharpened, also, and the whole shape is calculated to reduce air resistance, but principally, and briefly, it reduces the extent of the vacuum created in the air by the progress of the bullet or shell, and as this vacuum exerts a backward pull the backward pull is also reduced and the progress of the projectile less impeded.

It was desired to photograph the standard rifle bullet, moving at 32,400 inches a second, but even with an exposure of 1/32,400th of a second, the bullet would move an inch. Time was reduced to one ten-millionth of a second by using an electric spark and damping the discharge.

From study of the pictures the means to attain greater range was learned.

We have improved the 4.7 gun which fired a forty-five-pound shell 8,700 yards so that it now throws a fifty-pound shell 25,000 yards. The 155-millimeter howitzer in the war fired a ninety-five-pound shell 12,000 yards, but now it throws the same shell 15,800 yards.

THESE guns also can cover greater areas, due to the split trail, with which practically all field guns are now provided, which enlarges the traverse of heavy mobile artillery from eight to sixty degrees. And by caterpillar mounts and rubber tires lighter batteries can move thirty miles an hour! During the war they moved five.

The most mighty gun in the United States today is the sixteen-inch coast defense gun that throws a 2,340-pound projectile thirty miles to pierce fourteen inches of face-hardened armor. Its hitting power has been more than doubled since 1918.

Probably the deadliest weapon developed in the last war was the machine gun. Today the United States Army believes it has the best of these in the world. (*Continued on page 170*)

Bowen Made $1,000 a Month

Dear Mr. Dobe:—

"I've been averaging *better* than $1,000 monthly the past 6 months. There will also be profits from my patent that your individual training enabled me to create and design. Engineers estimate this patent to be worth $500,000. I owe all this to your instruction and the fine advice and help you have given me."

R. H. Bowen

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Bowen answered my advertisement and got my Free Book on Draftsmanship. Won't you write for it too? Now?

Bowen was then a stationary steam engineer and knew absolutely nothing about drawing but he took my simple, easily understood and quickly learned course in drafting—without giving up his job. You can do the same thing. Bowen climbed to success quickly. See where he says he owes it all to my instruction and advice. If Bowen did it, why not you! Even if you think you might not, you've got to admit it's worth a try.

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Getting Ready for the Next War

(*Continued from page 169*)

Range has been increased from 3,500 yards in 1918 to 5,700 yards.

As to the nature of the next war on the sea, there are two schools of thought. The air enthusiasts, led by Admiral Sims, believe bombing airplanes and seaplanes, seconded by submarines, will revolutionize sea warfare.

Professor A. M. Low predicts an armored "subma-plane," that can travel in air, water or under water. The French Navy has completed the largest submarine in the world, with tonnage of 3,000. Prof. Oswald Flamm, who designed German U-boats, now plans a cruiser submarine of 7,067 tons, 403 feet long, carrying two eight-inch guns. The most powerful British submarine is the *X-1*, of 2,780 tons, 351 feet long, with four-inch guns and with twenty-one-inch torpedoes. This can remain submerged two and one half days and go anywhere.

OUR own V-boats would stack up well with the *X-1*. Japan has ten big new submarines that could cross the Pacific and return, and her program calls for eight more.

France is pretty well ahead in the development of the other principal new naval weapon, the flying boat. The newest French creation is ninety-eight and one half feet long, weighs over seventeen tons and can carry a great weight of bombs.

Rear Admiral William A. Moffett, Chief of the Bureau of Aeronautics of the Navy Department at Washington, says:

"The first shot fired in the next naval battle will be an airplane shot from the deck of a surface ship, and the battle in the air for air supremacy will be preliminary to the surface engagement which must be the final and conclusive argument."

And the design and installation on American ships of catapults for launching airplanes is far ahead of that of any other country

British battleships are 6,000 tons larger than during the World War. The two new ships, the *Nelson* and the *Rodney*, carry sixteen-inch guns hitherto confined to coast defense, throwing shells 10,000 yards farther than the most powerful guns at the Battle of Jutland. These ships displace 35,000 tons and will cost about $30,000,000 each. The Japanese *Nagoto* and *Mutsu* come close behind, and so do our *Colorado, West Virginia* and *Maryland*.

"Medical science has kept pace with new weapons," says Major Louis Livingston Seaman, who has served in every American campaign since the Spanish-American War and in the armies of Japan and Belgium, and is now president of the American Surgeons' Travel Club. The increased knowledge of antisepsis today is probably the greatest stride forward. The death rate from disease among troops has decreased in the American Army steadily, from 100.46 per 1,000 in the Mexican War to 14.08 per 1,000 in the World War.

IT IS strange, perhaps, but true that here in the United States the scientific war men are not so strong.

Major General Charles P. Summerall, Chief of Staff of the Army, says:

"In the final analysis war is the problem of a soldier with a bayoneted rifle—perhaps an automatic rifle—in his hands, going somewhere to take a piece of land held by another soldier with a bayoneted rifle—perhaps an automatic rifle—in his hands."

And General Pershing said in his farewell report:

"We are logically forced back to the conclusion that armies must still fight our battles and to win must overcome the opposing forces. Since the beginning of history man has overestimated his newest accomplishment. This has been particularly true of the means of making war."

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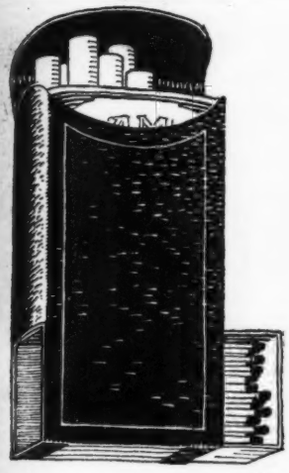

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50 Years Building Church

(*Continued from page 25*)

standing in a city where the average life of a commercial structure has been estimated by one authority at as little as thirty-five years. It is thirty-six years since work was begun on the cathedral. Fifty-four years have passed since the charter was granted for the project.

Completion will require at least ten years more—perhaps twenty if there are delays in financing as there have been in the past.

A half century, however, is not so long in the construction of a cathedral. This one, about half finished, is being built to stand a thousand years, or two thousand.

There are structural problems which do not yield to speed. St. Paul's in London was built rapidly, and it took thirty years. The Cologne cathedral, founded a little before the fourteenth century, was finished 580 years later.

WHEN the first cathedrals were built, structural steel was unknown, and tradition still dictates the use of solid masonry. Massive granite blocks, many of them weighing ten tons, swing into place in the rising walls of the nave of St. John's. Except for scaffolding, no wood is used.

Roofs and ceilings are arched. Even the ceiling of the crossing, spanning an open space 100 feet square, supports itself by its arch. The flat floor of the nave, which with the crossing will accommodate more than 10,000, rests on the arched ceilings of the crypt.

Working with stone, one of the most ancient building materials, and following the traditional lines of Gothic architecture, the builders of St. John's cathedral have, nevertheless, brought the most modern science and equipment to simplify their problems.

Granite is quarried to order and cut by power-driven saws. Every block's exact weight, size and shape are minutely calculated. A motor truck hauls it alongside the wall and an electrically-driven steel crane hoists it into place in a few minutes. In the Middle Ages materials had to be hauled up long, inclined runways, and the tractive power was often human.

When the contractor prepared to build the nave of St. John's he was confronted with a puzzling situation. He visualized the piers rising ninety-eight feet, a height surpassed by few if any in the world, and above them the arched ceiling springing to its ridge 130 feet from the floor.

NOW the ceiling, he knew, would support itself once it was completed. But until its arched sides met, until the keystones were set at the very top, it would have to be held up by scaffolding. The supporting piers of stone would range in two rows, sixty feet apart. Each arch or rib would carry a weight of 250 tons. In the central clear space there would be nothing on which the scaffolding could be set, between the floor and the ceiling. To be made substantial enough, the timbers would have to fill almost the entire building.

Still another problem was presented by the walls and piers themselves. As they rose far away from the ground, no intermediate "stories" would be afforded as working levels. The machinery for hoisting the granite and limestone would require a strong foundation. The nave floor, laid eight years before, would not suffice. It was of tile construction, supported by the arched ceilings of the crypt.

Now structural steel, barred as an integral part of the cathedral, became an important factor in its completion.

The foundations for the great sixteen-foot thick piers had been built up through the floorwork to a level with its surface, and were somewhat larger in area than the piers themselves. Using the surplus spaces on these sturdy footings as bases, the contractor had a structural steel framework erected. (*Continued on page 172*)

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50 Years Building Church

(*Continued from page 171*)

This steel structure with beams across its top would serve as a floor to hold the scaffolding which would support the roof, but it was useful long before construction reached the roofing stage. Six electrically powered steel derricks were built upon it. Each had a seventy-foot boom or lifting arm capable of hoisting fifteen tons, and together they served all parts of the nave.

ADVANCING science has contributed various improvements not dreamed of when the cathedral was begun. It is doubtful if the original planners ever hoped that a speaker in the pulpit would be heard simultaneously at both ends of the church, about two city blocks apart. It was expected that in St. John's, as in the Old World cathedrals of that time, the listeners would be grouped in relatively smaller areas. Today there is a microphone in the pulpit. A single voice carries to the remotest portions of the church.

The builders cannot guess what new marvels of science will become available, but wherever possible they are providing for unexpected developments.

Electrical conduits are being built with capacities far greater than required at present, so that additional wiring may be installed without disturbing the masonry.

Steam will do a novel service beside ordinary heating. In winter it will be turned on to thaw ice and snow in the drainpipes which carry water from the roof down through the inside of the walls. At the gutter openings will be connections to supply live steam.

Drainpipes and electric conduits are not the largest passageways hidden behind the heavy stones of the building. A visitor may discover this as he passes one of the huge piers. Outwardly it seems to be a solid column of rock, some sixteen feet thick. But in the side there is a doorway which leads to a winding staircase, two feet wide. The steps go down to the basement and up through the top of the pier. When the nave is finished they will lead to the space between the ceiling and the roof—a climb of 125 feet through a stone column. In the opposite pier across the nave will be another such stairway, and there will be two more in the west front.

AN impressive feature of the cathedral is its organ, a massive instrument with four keyboards, 7,000 pipes and a chime. It is operated electrically by an organist who sits, invisible to the congregation, watching the choir by reflecting mirrors fixed to the balconies.

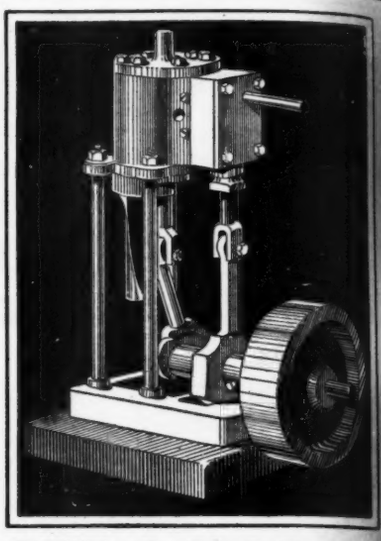
The metal reeds are so delicate that they are tuned each week to offset expansion and contraction caused by changes in temperature. A motor pumps air to the instrument in St. John's. Six persons still tread upon bellows in the Notre Dame cathedral of Paris.

The great distances within the cathedral are graphically realized when one sees a visitor gazing with binoculars at the magnificently colored windows, 100 feet above the floor. Of the windows, costing at least $10,000 each, seven are nearly thirty feet tall.

When excavation for St. John's was begun in 1891 the engineers discovered that much of the surface bedrock which had been considered solid was in reality rotten. In some places it was necessary to dig down seventy-two feet.

They were not yet certain. A specimen of the rock was ground down to a thickness of 4/100 of an inch, on a jeweler's emery wheel, and its structure was minutely studied. Then it was pronounced safe.

Years later a similar problem was encountered in preparing the foundation for the nave. Before trusting a ledge of rock as a base for a pier or wall workmen would drill holes six feet deep. If unsound (*Continued on page 173*)



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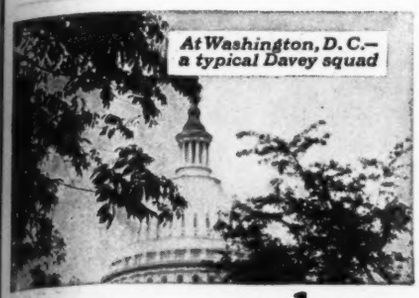

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50 Years Building Church

(*Continued from page 172*)

rock was found, it was blasted and scooped out. Then five more test holes were drilled. There were places where fifteen feet of rock had to be removed.

The builders know the dangers of insecure foundations. The bell tower of St. Mark's cathedral at Venice, built on a damp island, fell and had to be reconstructed. Undulations developed in its floors. In St. Paul's, in London, twenty-eight buttresses cracked as a result of drainage of the sand and gravel foundation. The two western towers of famous Westminster Abbey caused serious concern some years ago. The builders of St. John's have spent more than a million dollars for the granite and concrete foundations. Each pair of piers in the crossing, with their massive connecting arch, weighs 4,000 tons, and the 400-foot central tower has not yet been built.

WHEN work on the cathedral was begun, it was realized that years would be required for completion, and construction was planned in such a way that each unit could be used as it was finished. Eight years after the work started, the first services were held in the almost completed crypt, or basement.

The huge piers rose for the crossing, and the 100-foot gaps between them were spanned with arches. This section, with the choir, sanctuary and chapels, is used today.

The eight great columns in the sanctuary, according to the original plan, were to be monoliths, single pieces of granite, costing $25,000 each. As such they would have been the largest in the world.

They were quarried on an island near the coast of Maine. The contractor had no lathe large enough to turn and polish them, so he built special equipment costing $50,000.

But the size of the columns was too great. They weighed 130 tons each, and were fifty-five feet long. After two had sagged and snapped in the lathe, permission was granted to deliver the columns in two pieces each. Even so, they were the greatest of their kind.

The task of erecting the columns in the sanctuary was a delicate one. Three thirty-horsepower engines supplied the power. Weeks were spent in making calculations for the placing of each of the shafts; the hoisting was done in fifteen minutes for each column.

As a result of financial difficulties, work lagged on the cathedral for a number of years. The passage of time has left its mark even on the wall of the nave. Just below the fresh granite blocks being placed today, there are others darker from having lain on the ground for years while funds were being raised.

THE original architects of the cathedral were George L. Heins and C. Grant La Farge. After Heins' death in 1907 La Farge served until completion of the choir in 1911, since when the architects have been Cram and Ferguson. Henry Vaughan was architect of three chapels; Carrere and Hastings of one.

The original plans called for a dome; then a huge spire, more than 500 feet tall, was suggested. An almost insurmountable problem developed. The crossing was more than 100 feet square. A tower or spire erected above the space would dwarf the rest of the building, including the two fifty foot square towers planned for the west front, at the end of the nave. Only this year the architects found a solution, never before used.

The huge arches on each side of the crossing will be used as a foundation for secondary arches, rising above them. The secondary arches will intersect above the crossing, forming a square sixty feet on each side, upon which a 400-foot tower will be erected.

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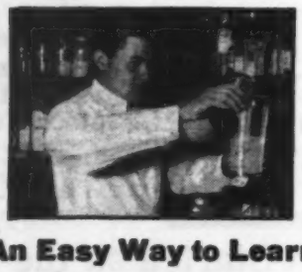

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Clothes Woven from Rock

(*Continued from page 31*)

Of course, iron holders, mats and stands, gas burners and gas logs, are commonly known, but not many are aware that asbestos-composition floors also are being laid, unburnable and ever-wearing.

"Your stoves and ovens are so efficient because of the same heat-wave resistant. If you started to uncover all the asbestos in your home you would have to take apart the electric wires, all your electric appliances, phonograph records, radio parts, even your telephone mouthpiece. Few common materials are fire- or even heat-proof. Only asbestos stands between us and the fire demon.

"Heating plant pipes in modern houses are covered with asbestos mixed with magnesia or a similar substance, saving as much as 180 pounds of coal per square foot of boiler surface, which in the heating season of 210 days amounts to five or ten tons. Because the majority of homes are still trying to 'heat all outdoors,' however, $300,000,000 worth of coal is still being wasted.

"IN POWER plants every hot piston stem, steam joint, pipe, strap and valve has its asbestos packing and gaskets. We could not begin to retain and handle these enormous but efficient forces without asbestos and graphite. Even electric switchboards, insulators and panels are molded from it, while tiny fibers are made into lamp filaments.

"You can live in a completely fireproof home if you desire, made of asbestos lumber and roofed with asbestos shingles or tiles. Not long ago a whole trainload of fireproof houses were shipped to a firm in St. Louis, for its employees. You can buy asbestos tapestries, rugs, table covers and even rope ladders.

"Chief of asbestos parts in motor cars are the brake linings, for which we have to thank C. W. Raymond. Back in 1905, while Ford was still experimenting, Raymond tried mohair leather and other materials, none of which would stand up under the high heat and pressure of a friction brake. Asbestos with woven brass wire solved the problem and Raymond patented the brake lining, seventy-five million feet of which stops twenty million cars today.

"Our safe steel railroad coaches were once thought impracticable, because of the difficulty of insulating against cold and rumbling. Now cattle hair between layers of asbestos keeps them at vaporless temperatures. Ships' bulkheads are made fireproof with asbestos boards.

"ASBESTOS is just beginning to take to the air, around the motors and as insulation. But tank covers would save accidental fires, and asbestos mail bags would save letters as readily as the asbestos suit used to save the 'human comet' of bygone country fairs. He had gasoline poured over him and lighted, and then plunged in a blaze of glory into the tank beneath."

Although Benjamin Franklin had an asbestos purse, doubtless to keep his money from "burning a hole in his pocket," it was 1868 before asbestos began to be used here, for roofing felt and in cement. Years before, the French had made it into firemen's suits, to Napoleon's delight. The Italian Albonico tried to make government notes of asbestos paper. In the '70's H. W. Johns and an English firm began to make really useful articles from the fibers, and its vital part in the growth of industry was soon realized. The tremendous expansion of mining of asbestos, especially of the "chrysotile" of Quebec, is one of the romances of the age.

In 1876 Italian miners began to toil up winding mule paths to the 6,000- and 10,000-foot Alpine mines in the Susa and Valtelina valleys. They brought the asbestos swiftly down in toboggans. In 1904 an avalanche overwhelmed over a hundred miners and their huts.

But the Italian product was too scarce and expensive. In 1878 the immense Quebec deposits were opened. The fibers were shorter, but some were long enough to be woven, and they were much stronger than the Italian. The miners followed the glistening veins, a quarter inch to several inches thick, 500 to 1,000 feet wide, for miles and miles through the fire-denuded hills. The more they mined, the more was wanted. Fibers over three quarters of an inch long have never equaled the demand.

"In places," says James G. Ross, mining engineer of Canada, "almost the whole rock is fibrous. Talc and soapstone occur in the asbestos. While the fiber appears to be solid rock, it may be pulled apart in fine shreds which resemble silk threads. French Canadians call it 'cotton'."

In the vast open pits dynamite blasts huge blocks loose from the mother lode. Textile machinery cards, winds and spins the floss which is woven like flax.

In 1879 the miners had a hard time getting $65 a ton for 300 tons. By 1890 the price of "No. 1. Crude," the highest regular grade, was $126 a ton. By the beginning of the World War it brought $300 to $350. By 1917 Canada was producing eighty-five percent of the world's supply and obtaining $900 to $1,700 a ton for No. 1. In 1919 best grades brought $2,500 to $3,000, and in 1920 select fibers, over two inches long, sold for over $4,000 a ton! Last year almost 230,000 tons crossed the American line, worth over eight million dollars. No. 1 Crude is now quoted at $525, while long fibers run much higher.

A KEEN Canadian first saw how to make shingles, cements and compositions of the very short fibers that had been regarded as waste. "Asbestic," today, mixed with lime or other substances, makes hundreds of articles.

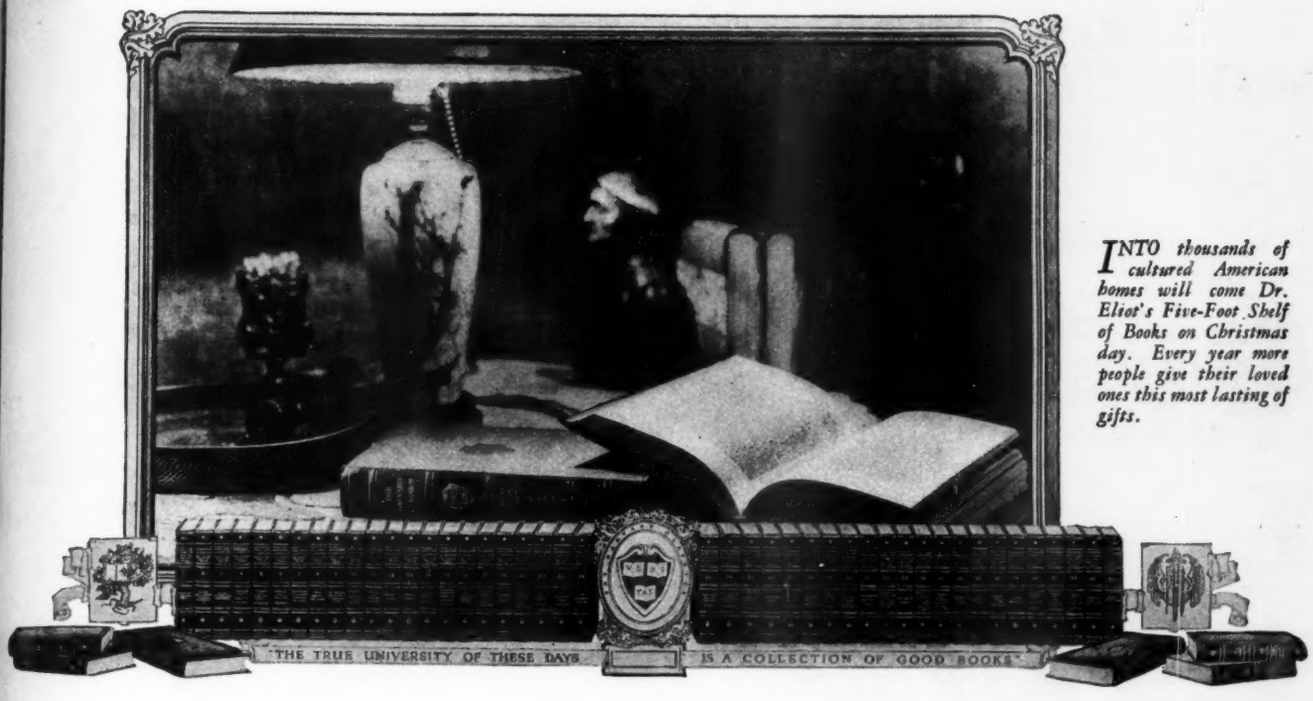
Chrysotile asbestos has been found in Central Park, New York, and in Wyoming, Nevada, North and South Carolina, Virginia and California. The Sall Mountain mines of Georgia have been worked for some years, while in Idaho, near Kamiah, it is planned to make asbestos paving material. This might take the place of good intentions in warmer climes. Comparatively little from the wide-spread deposits of this country is acceptable to the asbestos makers.

Travelers in the depths of the Grand Canyon of Colorado have seen asbestos veins at a depth of over 4,000 feet below the rim, proving the age of the material. Indeed, it is considered the most ancient material which the hand of man has uncovered. Other deposits have been worked higher up on the walls of the canyon. Only burros are available for packing, and thus, although the fibers are six to eight inches long, strong and silky, they are hardly able to compete with Canadian fibers.

Thus the field is still wide open for the prospector, for this country supplies scarcely one percent of its needs. Fire barriers in oil refineries demand an enormous quantity. All plants which handle splashing molten materials and white-hot flames have constant need for asbestos clothes, gloves and tools. Chemical plants and laboratories must have it for filters, retorts and tanks, for it is impervious to most acids, lubricants and alkalis. Sulphuric acid vats are calked with it. "Fibrous enamel" makes a heat-resistant film for steel and wood. Thousands of castings have been made from permanent molds of asbestos composition.

Long ago the theater adopted asbestos for its curtains. About one thousand are now made each year.

Charlie Chaplin, using an acetylene torch in one of his films, set his baggy trousers afire, but asbestos underwear saved the world's best-known comedian from injury.



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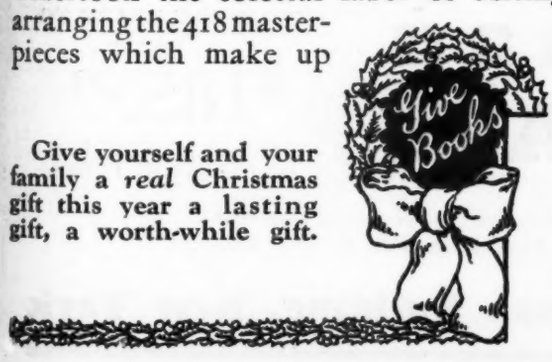

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